

Health Consultation

ASBESTOS EXPOSURES AT OAK RIDGE HIGH SCHOOL
1120 HARVARD WAY
EL DORADO HILLS, CALIFORNIA

EPA FACILITY ID: CAN000906055

JANUARY 31, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Table of Contents

Background..... 1
 Peer Review / Public Comment 1
 History..... 1
 Asbestos Background..... 2
 Asbestos Health Effects 3
 Purpose of This Report 4
 Environmental Data Evaluated 4
 Indoor Air Sampling 4
 Outdoor Air Sampling..... 5
 Soil/Dust Sampling 6
 Current and Future Status of Site..... 6
 Exposure Pathway Analysis..... 8
 Discussion 8
 Exposure Assessment and Toxicological Evaluation 8
 Current Exposures..... 9
 Past Exposures 10
 Uncertainties 14
 Health Outcome Data..... 15
 Child Health Considerations 16
 Conclusions..... 16
 Recommendations..... 17
 Public Health Action Plan..... 17
 Site Team 19
 References..... 20
 Appendix A. Peer Review Comments and Responses..... 26
 Appendix B. Asbestos Overview 36
 Appendix C. Mesothelioma Incidence in Western El Dorado County..... 41
 Appendix D. Public Comments Received 42

Background

Oak Ridge High School is located at 1120 Harvard Way in El Dorado Hills, California, about 30 miles northeast of Sacramento, in El Dorado County. Naturally occurring asbestos has been identified in rocks and soils on and around school property, and a vein of asbestos was disturbed during construction of a soccer field in 2002. A community member, who had been active for several years in voicing concern over asbestos exposures in the area, asked the Agency for Toxic Substances and Disease Registry (ATSDR) to evaluate the public health implications of current and past asbestos exposures of students and staff at the high school. In this public health consultation, ATSDR reviews available environmental data and potential exposure pathways to determine whether adverse health effects are possible from past or present asbestos exposure at Oak Ridge High School and recommends actions to prevent, reduce, or further identify the possibility for adverse health effects. ATSDR has also received numerous reports of health-related concerns about the area surrounding the high school and other areas with naturally occurring asbestos. The US Environmental Protection Agency (EPA) is currently collecting and analyzing data on asbestos levels in other areas of El Dorado County, and ATSDR will address those pathways in a subsequent health consultation.

Peer Review / Public Comment

Many issues in asbestos science are currently debated among scientists. ATSDR requested a draft of this public health consultation be “peer reviewed” to ensure that the evaluation performed in the document was done using the best science given the nature of the available information. The public health consultation was reviewed by three asbestos science experts who have no affiliation with ATSDR. Appendix A contains further information about the peer review, the questions posed to the peer reviewers, their comments (verbatim), and ATSDR’s responses to the comments.

ATSDR released a draft of this health consultation (including peer review comments and responses) in May 2005 for public comment. This revised final version includes written public comments received (verbatim) and ATSDR’s responses in Appendix D.

History

Oak Ridge High School was constructed in 1980. According to state reports, the presence of naturally occurring asbestos in the general area was previously known and documented [1]. Because of community concerns about asbestos, the California Air Resources Board (CARB) performed ambient air sampling at the school in 1998 and 1999. In 2002, the El Dorado Union High School District (EDUHSC) began construction of two soccer fields at the school. During construction, a vein of white fibrous material was uncovered and found to contain 90% asbestos (of the amphibole variety). Construction was delayed, and questions arose as to release of asbestos fibers from the construction site, erosion of contaminated soils downhill towards the school building, and levels of asbestos in soil in other parts of the campus. The school district performed activity-based sampling that showed airborne asbestos could potentially be released by activities at athletic fields under dry conditions. EPA performed soil testing that showed that

amphibole asbestos fibers were present in school soils (testing of the same soil samples by the school district gave conflicting results). Classrooms were cleaned, and testing was performed by the school district to ensure that the classrooms were safe for occupancy by students. In addition, activities were initiated to mitigate the risk of exposure to potential asbestos-containing soils at athletic fields and in other areas of the campus. Campus mitigation activities were completed in November 2004 [2].

Asbestos Background

Asbestos is a general name, for regulatory purposes applied to a group of fibrous silicate minerals including chrysotile, the main type used commercially, and fibrous amphibole-type minerals (including actinolite, anthophyllite, crocidolite, tremolite and amosite) [3]. Whereas chrysotile has relatively long and flexible crystalline fibers, amphibole minerals are brittle and have a rod- or needle-like shape [3]. Breathing either type of asbestos, and probably other fibrous asbestiform materials which are not currently regulated, into the lungs increases a person's risk of developing a rare cancer of the lung or abdominal lining called mesothelioma, lung cancer, or certain types of nonmalignant respiratory disease. Many scientists believe that the amphibole varieties of asbestos are more potent in causing mesothelioma, and possibly other asbestos-related disease, than is the chrysotile variety, because the amphibole fibers remain in the lungs longer [3].

Most commonly, asbestos is formed geologically in rocks of the ultramafic variety (iron-magnesium silicate minerals), but may also occur in carbonate, granitic, or other rock types. Two of the more common types of rock that can contain asbestos are serpentinite and talc. Both chrysotile and amphibole varieties of asbestos can be found associated with these rock types.

For many years, asbestos (mainly chrysotile) was mined and used in many commercial products, including insulation, brake linings, building materials, and flooring. The term "naturally occurring asbestos" has come into use to refer to asbestos as a natural mineralogical component of soils or rocks as opposed to asbestos released from commercial products or mining and processing operations. Suspension of naturally occurring asbestos fibers into air occurs incidentally with natural processes, such as erosion, or human activities unrelated to the asbestos, such as construction, soil tilling, or automobile or foot traffic. **For a given size, shape, and mineralogy of fiber, naturally occurring asbestos is indistinguishable from and carries the same health risk as asbestos from a commercial material.** Therefore, in this consultation ATSDR refers to asbestos fibers in general, without reference to the source. The type of asbestos (chrysotile or amphibole) may be specified if it is known. Information available about sampling at and around Oak Ridge High School indicates that most of the asbestos fibers detected have been of the amphibole type, specifically the closely related amphiboles tremolite and actinolite.

Asbestos Health Effects

Breathing any type of asbestos increases the risk of the following health effects.

Malignant mesothelioma—Cancer of the membrane lining the chest cavity and covering the lungs (pleura) or lining the abdominal cavity (peritoneum). This cancer can spread to tissues surrounding the lungs or other organs. The great majority of mesothelioma cases are attributable to asbestos exposure [3]. Many scientists believe that amphibole asbestos fibers have a potency for causing mesothelioma that is as much as 100 times greater than that of chrysotile fibers, mainly because of increased persistence of amphiboles in the lungs.

Lung cancer—Cancer of the lung tissue, also known as bronchogenic carcinoma. The exact mechanism relating asbestos exposure with lung cancer is not completely understood. The combination of tobacco smoking and asbestos exposure greatly increases the risk of developing lung cancer [3].

Noncancer effects—These include *asbestosis*, a restrictive lung disease caused by asbestos fibers scarring the lung; *pleural plaques*, localized areas of thickening of the pleura; *diffuse pleural thickening*, generalized thickening of the pleura; *pleural calcification*, calcium deposition on pleural areas thickened from chronic inflammation and scarring; and *pleural effusions*, fluid buildup in the pleural space between the lungs and the chest cavity [3]. Loss of lung function or other clinical signs may or may not be associated with these noncancer effects.

Weak evidence exists that inhalation of asbestos may increase the risk of cancer in the gastrointestinal tract (because of swallowing of fibers removed from the lung by mucociliary transport). However, the studies are conflicting and show a much weaker effect than the proven correlation of asbestos inhalation with cancers of the lungs, pleura, or peritoneum [3].

Ingestion of asbestos causes little or no risk for noncancer effects. However, some evidence exists that acute oral exposure might induce precursor lesions of colon cancer and that chronic oral exposure might lead to an increased risk of gastrointestinal tumors [3]. Dermal exposure to asbestos is associated with the formation of small warts or corns, particularly on the hands.

ATSDR considers the inhalation route of exposure to be the most significant in the current evaluation of Oak Ridge High School. Actions taken to limit inhalation exposures will minimize risk from dermal and oral exposures as well.

The risk of health effects from breathing in asbestos increases with the concentration of fibers inhaled, how often and how long the fibers are inhaled, and the length of time since the first exposure occurred. Asbestos-related lung disease has been identified in several communities around the world with naturally occurring asbestos, including areas of Greece, Turkey, Corsica, Italy, Sicily, Cyprus, China, and New Caledonia [3–16]. Similarly, disease associated with environmental-level exposures has been identified in people living near mines or processing operations for asbestos or asbestos-containing minerals, such as in Libby, Montana, or in Wittenoom, western Australia [17,18]. However, little information exists on the exact levels of asbestos exposure experienced by these communities, and exposure characteristics might differ

significantly from those of other areas where environmental exposures are possible. It is not possible to extrapolate these findings to other areas in an attempt to predict the likelihood of disease.

Various authorities have set standards, created regulations, and made recommendations regarding asbestos to protect public health and the environment. For inhalation exposure, occupational regulatory and advisory agencies recommend that workers' exposure be limited to 0.1 fibers per cubic centimeter (f/cc), averaged over a typical work week and usually based on 25 years of exposure [19,20]. Although useful as a point of reference, ATSDR does not support using worker asbestos limits for evaluating community member exposures, because the worker limits are based on risk levels that would be considered unacceptable in nonworker populations. In response to the World Trade Center disaster in 2001 and an immediate concern about asbestos levels in buildings in the area, the Environmental Assessment Working Group (made up of federal, state, local, and private entities) set a reoccupation level of 0.01 f/cc after initial cleanup, with continued monitoring recommended to limit long-term exposure at a clearance level of 0.0009 f/cc [21,22]. The 0.0009 f/cc level is based on EPA's current asbestos cancer slope factor for combined lung cancer and mesothelioma, with a 1 in 10,000 increased risk over a 35-year occupancy. This slope factor was derived from a group of epidemiology studies of various chrysotile, amphibole, and mixed asbestos exposures. The derivation assumed chrysotile and amphibole asbestos have equal potency for causing cancer. [23].

More details about asbestos can be found in Appendix B of this document.

Purpose of This Report

In this public health consultation, ATSDR will evaluate the environmental data collected at Oak Ridge High School to see whether it is possible to estimate potential exposures to asbestos, both past and present. ATSDR will discuss public health implications of potential exposures to students and staff and make recommendations, if necessary, for minimizing the health impact of potential exposures.

Environmental Data Evaluated

Although ATSDR attempts to summarize all asbestos data collected at the school, this report is not necessarily comprehensive, and raw data are not included (original reports should be requested from the agency responsible for collecting the data). In addition, not all data types reviewed were appropriate to use for estimating exposures. Those data would not have been used directly in calculations, although the results may have been taken into consideration.

The following sections summarize the data evaluated by ATSDR for this public health consultation. The data fall into several categories, described below:

Indoor Air Sampling

- In 1998, 2002, and 2003, the school district sampled indoor air in selected classrooms and other indoor areas of the school [24,25,26].

- In 2003, the California Department of Occupational Safety and Health performed limited air sampling in some classrooms [27].
- In 2003 and 2004, the school district sampled air in classrooms and other indoor areas of the school after the areas had been cleaned [28]. The data obtained were assumed to represent potential exposures to students and staff in classrooms at present.
- In 2003, the school district sampled indoor air to determine whether one classroom was affected by dust blown in by a leaf blower operating nearby [29].

Outdoor Air Sampling

- In 1998 and 1999, CARB collected ambient air samples in outdoor locations at the school to assess ambient asbestos levels [30]. No construction or disturbance of soil was occurring during this sampling. These data were assumed to represent general exposure of the public.
- In 2002 and 2003, the school district and/or CARB collected several sets of air data outdoors during excavation and mitigation activities that were expected to disturb naturally occurring asbestos in soil [1,31,32,33,34]. Soil wetting and dust suppression requirements of the El Dorado County Airborne Toxic Control Measure (ATCM) were followed during these activities. Area samples were collected at various places (within the work area, on the perimeter, and at locations outside the work area), and personal samples were collected from monitors worn by equipment operators or other personnel. These data were assumed to represent potential outdoor exposures of students, staff, and workers to asbestos during mitigation activities.
- In 2003, the school district collected air samples to assess potential exposures at athletic fields on campus [35]. Activities such as dragging the track were performed during the sampling so that the sampling would better reflect asbestos concentrations that might be present while athletic fields were being used. Dust suppression and soil wetting were not performed during this testing. Both area samples and personal samples were collected. These data were assumed to represent potential exposures of students, staff, and spectators during sporting practices and events.

In most cases, air samples were analyzed using transmission electron microscopy (TEM) with a modified Asbestos Hazard Emergency Response Act (AHERA) method (counting structures longer than 0.5 μm and with aspect ratios greater than 3:1; structures refers to asbestos fibers, bundles, clusters, and matrices). Some personal monitors were also analyzed using phase contrast microscopy (PCM, counting fibers longer than 5 μm and with aspect ratios greater than 3:1), as required for occupational safety compliance. For the purposes of the exposure estimates and analysis in this consultation, ATSDR treated equivalently the two units of measure, structures per cubic centimeter (s/cc) and f/cc.

In general, fiber counts determined using PCM are not directly interchangeable with structure counts determined using AHERA counting rules with TEM. However, for the approximate analysis performed in this health consultation, total s/cc counts (the result reported on summary sheets) were used interchangeably with f/cc counts. After examining the TEM raw data sheets for the activity-based sampling, ATSDR noted that structures greater than 5 μm in length contributed 50% or more to the total structure count. Therefore, estimates of exposure using the total structure count and those using only structures greater than 5 μm in length will differ by

only a factor of two. In addition, the raw data sheets identified the mineralogy and characteristics of reported structures. All structures contributing to the total structure count were asbestos fibers. Therefore, using s/cc and f/cc interchangeably is a reasonable approximation in this instance.

Soil/Dust Sampling

The following materials were sampled and tested to determine asbestos content:

- soils from athletic fields and the former dirt parking lot [36,37,38],
- materials from veins of mineral uncovered during the soccer field excavation [38],
- soil and fill materials associated with baseball and softball fields [39,40,41,42],
- soil samples from athletic fields and bare areas throughout the campus [43], and
- dust collected from the classroom potentially affected by a leaf blower [44].

Although important to show the presence or absence of asbestos, **soil and dust data are of limited use in predicting potential exposures**. This is because little is currently known about the correlation between soil or dust concentration and resulting air concentration of suspended fibers. Trace levels of asbestos in soil are defined as levels less than 1%—the level used by OSHA to define “asbestos-containing materials” and the “action level” in soil historically used by EPA for risk management purposes. However, studies have shown that air concentrations of suspended asbestos fibers can reach levels of concern when the soil contains trace levels of asbestos [45]. Conversely, soils containing more than 1% asbestos may not release fibers to air to an appreciable extent if the soils are not disturbed or if soil characteristics keep fibers attached strongly to the soil particles.

Current and Future Status of Site

Remedial efforts:

Many of the environmental sampling data were collected before mitigation activities that have since been completed. ATSDR concluded the following mitigation activities were protective of students and staff at ORHS and have lowered exposures:

- Mitigation of soccer fields, including grading and covering native soils with geotextile fabric, 24 inches of clean topsoil, and sod, was completed in 2003. Cut banks were also sprayed with materials to reduce erosion or other release of asbestos fibers.
- Mitigation of the baseball and softball fields, which included replacement of fill materials with clean fill, was completed in 2004.
- The track around the football field was paved in 2003.
- Paths and bare areas were paved or landscaped in the spring and summer of 2004.
- Mitigation of remaining areas (bare soil under bleachers, piles of removed soil) was completed in the summer of 2004.

Classroom testing:

Indoor air sampling of classrooms in the summer and fall of 2003 indicated that the average level of asbestos in three air samples from most rooms was lower than 0.0009 f/cc. One room had a higher average level (0.0015 f/cc), but after a second cleaning, it was retested and the average level was found to be below 0.0009 f/cc. Classrooms tested in the summer of 2004 all had asbestos air levels below 0.0009 f/cc, with one exception. This classroom, a science classroom, was found to be

contaminated with chrysotile asbestos from transite countertops used for lab counters [personal communication, Gerry Hiatt of the U.S. Environmental Protection Agency, Region 9, November 2004]. The countertops were encapsulated per AHERA standards [personal communication, EDUHSC, June 2005]. On the basis of the available data, no adverse health effects are expected from exposure to asbestos at current classroom levels. Ongoing sampling of classrooms is essential to confirm the safety of the classrooms over time, prove efficacy of the cleaning program, and confirm that recontamination is not taking place.

The current status of the site was considered in evaluating exposures that might be taking place at present . Because most identified bare soil has been removed or covered with geotextile fabric and clean soil or landscape materials or paved, and because limited indoor testing has not shown asbestos at a level of concern ATSDR concluded that **current exposures** to asbestos have been minimized. That is, the current potential for exposure to asbestos from activities in the school or on school grounds is considered to be very low.

Future potential for asbestos exposure is dependent upon many factors, including maintenance of the cap (barrier installed during remediation), proper precautions during any disturbance of the cap, track-in from other areas, proper cleaning, and other factors. In the spring of 2004, ATSDR reviewed a draft operations and maintenance (O&M) plan prepared for the EDUHSC. At that time, ATSDR concluded that the O&M plan provided adequate controls to prevent future exposures. Since then, at the request of the EDUHSD, DTSC's School Property Evaluation and Cleanup Division entered into an agreement with the district to review and approve the O&M Plan for Oak Ridge High School. The revised O&M Plan establishes EDUHSD's policy for managing naturally occurring asbestos on the school campus [46]. The primary objective of this O&M Plan is to ensure the integrity of the cap and prevent exposures to soils laying beneath the cap. The plan does not address or consider potential exposure from unmitigated areas, from off-campus track-in, or from other off-campus sources.

ATSDR has reviewed the new O&M plan and submitted comments to DTSC on January 3, 2006. DTSC has agreed with the comments made by ATSDR and is currently working with EDUHSD to amend the agreement to include the changes. Because the new plan does not include steps ATSDR considers vital to limiting exposures in the future, recommendations for maintenance and/or testing in the school are included in the recommendations section.

Exposure Pathway Analysis

An exposure pathway is the way in which an individual is exposed to contaminants originating from a contamination source. Every exposure pathway consists of the following five elements: (1) a *source* of contamination; (2) *media* such as air or soil through which the contaminant is transported; (3) a *point of exposure* where people can come in contact with the contaminant; (4) a *route of exposure* by which the contaminant enters or comes in contact with the body; and (5) a *receptor population*. A pathway is considered **complete** if all five elements are present and connected. A pathway is considered **potentially complete** if it is currently missing one or more of the pathway elements, but the element(s) could easily be present at some point in time. An **incomplete** pathway is missing one or more of the pathway elements and it is likely that the elements were never present and are not likely to be present in the future. An **eliminated** pathway was a potential or completed pathway in the past, but one or more of the pathway elements have been removed to prevent exposures in the present and the future.

After reviewing information from community members and school officials, ATSDR identified possible exposure pathways for Oak Ridge High School. All pathways have a common source—*asbestos fibers that are present in soil*—and a common route of exposure—*inhalation*. Although asbestos ingestion and dermal exposure pathways could exist, health risks from these pathways are minor compared with the risks resulting from inhalation exposure to asbestos and will not be evaluated. The pathways evaluated in this public health consultation are listed below:

- *Classrooms*—exposure of students, teachers, and custodial staff to asbestos fibers suspended from contaminated dust inside classrooms
- *Sports Fields*—exposure of student athletes, coaches, spectators, and outdoor maintenance staff to asbestos fibers suspended from soil or fill materials at the soccer fields, baseball fields, softball fields, tennis courts, basketball courts, football field, or running track
- *Dirt Parking Lot*—exposure of students, staff, and visitors to asbestos fibers suspended from soil in the parking lot
- *Paths and Other Bare Areas on Campus*—exposure of students, staff, and visitors to asbestos fibers suspended from soil around classroom buildings and other areas of the campus

It should be noted that the exposure pathway analysis discussed is only for Oak Ridge High School. Additional pathways could be present in other community areas, on private roads, in residences, or in other areas where asbestos fibers could be suspended in the air and inhaled. These pathways are outside the scope of this health consultation; however, ATSDR will address them in a subsequent health consultation.

Discussion

Exposure Assessment and Toxicological Evaluation

This section evaluates current and past exposures to asbestos at the high school and potential health effects of those exposures. Evaluating the health effects of exposure to asbestos requires

extensive knowledge of both exposure pathways and toxicity data. Limited information exists about past levels of asbestos present in air around the school and school classrooms. The fact that information is limited makes it hard to estimate the quantity of asbestos to which people may have been exposed. In addition, limited knowledge of the type of asbestos fibers present and their size distribution makes determining potential toxicity difficult. Public health implications of past exposures at the school can therefore only be evaluated qualitatively.

Current Exposures

Classrooms

Indoor air sampling of classrooms in the summer and fall of 2003 indicated that the average level of asbestos in three air samples from most rooms was lower than 0.0009 f/cc. One room had a higher average level (0.0015 f/cc), but after a second cleaning, it was retested and the average level was found to be below 0.0009 f/cc. Classrooms tested in the summer of 2004 all had asbestos air levels below 0.0009 f/cc, with one exception. This classroom, a science classroom, was found to be contaminated with chrysotile asbestos from transite countertops used for lab counters [personal communication, Gerry Hiatt of the U.S. Environmental Protection Agency, Region 9, November 2004]. The countertops were encapsulated per AHERA standards [personal communication, El Dorado Union High School District, June 2005]. After this, the classroom was cleaned and tested to be below 0.0009 f/cc. The 0.0009 f/cc level is considered safe for classroom occupancy. On the basis of the available data, no adverse health effects are expected from exposure to asbestos at current classroom levels. Ongoing sampling of classrooms is essential to confirm the safety of the classrooms over time, prove efficacy of the cleaning program, and confirm that recontamination is not taking place.

Sports fields

Soccer fields—Asbestos at the soccer fields has been addressed by covering the exposed earth with a geofabric covering and placing 24 inches of clean fill on top of the fabric. Fresh sod and an irrigation system were also installed on/in the clean fill. The cut banks of the soccer field were sealed to prevent erosion. With effective operations and maintenance, these activities will prevent further release of asbestos fibers into air. No exposures to asbestos fibers or resulting adverse health effects are expected from current use of the soccer fields.

Baseball and softball fields—Fill materials on baseball and softball fields have been replaced with asbestos-free material. Therefore, no exposures to asbestos fibers or resulting adverse health effects are expected from current use of the baseball and softball fields.

Tennis or basketball courts—Because campus mitigation activities have covered or otherwise prevented NOA from being suspended or eroding from soil, asbestos fibers are not expected to be present on the tennis or basketball courts currently. Therefore, no exposures to asbestos fibers or resulting adverse health effects are expected from current use of tennis or basketball courts.

Football field and running track—The running track around the football field has been paved. Therefore, no exposures to asbestos fibers or resulting adverse health effects are expected from current use of the football field or running track.

Dirt parking lots

The dirt parking lots around the campus have been paved or otherwise mitigated to prevent release of asbestos-containing dust. Therefore, no exposures to asbestos fibers or resulting adverse health effects are expected from current use of parking lots.

Paths and other bare areas on campus

Bare areas around the campus have been paved or landscaped to prevent release of asbestos-containing dust. Therefore, no exposures to asbestos fibers or resulting adverse health effects are expected from current activities around bare areas on the campus.

Summary

Most areas on the campus have been mitigated to prevent release of naturally occurring asbestos fibers into the air. Assuming that the O&M Plan approved by DTSC is followed, exposures to asbestos fibers from campus soil should be minimized. Ensuring that asbestos exposure does not occur in the future requires the Oak Ridge High School administration to follow the DTSC O&M plan for the engineering controls and the recommendations made by ATSDR for monitoring and/or cleaning found in the recommendations section, below.

Past Exposures

Classrooms

Although the limited indoor air sampling prior to cleaning of classrooms detected no asbestos fibers, this sampling was performed using a low-sensitivity counting method that might have missed low levels of fibers (the detection limit was 0.005 f/cc compared with 0.0005 f/cc for later sampling). In addition, sampling prior to cleaning was performed with little or no agitation of dust in the classrooms, compared with the post-cleaning samples which used leaf blowers to suspend as many fibers as possible. Some asbestos fibers were detected in classrooms after an initial cleaning (concentrations ranging from <0.00048 to 0.00246 f/cc). Therefore, a reasonable assumption is that at least some asbestos fibers were present in classrooms before the cleaning and that exposure to asbestos fibers could have occurred there.

Sports fields

Soccer fields —An initial assessment of the area where soccer fields were to be constructed did not identify any asbestos [38]. After construction began in 2002, a vein of amphibole asbestos was uncovered. On the basis of the fact that no asbestos was identified initially and the fact that the areas where the soccer fields were constructed were not being used for regular organized activities, it is unlikely that potential exposures in this area before 2002 were great enough to result in adverse health effects. Activities at the soccer fields were halted from 2002 until mitigation activities took place in 2003. After mitigation began, soil wetting and other dust control measures were reportedly taken. Air monitoring performed during mitigation activities in the area showed a maximum of 0.0039 structures/cc (s/cc) and an average of 0.0008 s/cc.

Baseball and softball fields —In the past, exposure to asbestos fibers probably occurred at the ball fields. The baseball field soil contained trace levels of actinolite and chrysotile asbestos, and several softball field soil samples contained greater than 1% asbestos (actinolite and chrysotile). Activity-based sampling at the baseball field was conducted while the field was being raked and dragged to simulate game activities. Area monitors near the field detected levels of actinolite asbestos as high as 0.00143 s/cc, and personal monitors worn by the workers performing the raking and dragging detected levels of actinolite asbestos as high as 0.1023 s/cc.

Tennis or basketball courts—In the past, exposure to asbestos fibers could have occurred at the tennis and basketball courts. Activity-based sampling at the tennis and basketball courts was conducted while the courts were being swept to simulate game activities. Area monitors near the courts detected levels of actinolite asbestos as high as 0.0097 s/cc, and personal monitors worn by the workers performing the sweeping detected levels of actinolite asbestos as high as 0.045 s/cc.

Football field and running track—In the past, exposure to asbestos fibers probably occurred on the football field, on the running track, and in the spectator stands. Activity-based sampling at the running track around the football field was conducted while the track was being raked and dragged to simulate use of the track and football game activities. Area monitors on and near the football field detected levels of actinolite asbestos as high as 0.00345 s/cc, and personal monitors worn by the workers performing the raking and dragging detected levels of actinolite asbestos as high as 0.0614 s/cc.

Dirt parking lots

In the past, vehicular and pedestrian traffic on the dirt parking lots probably caused exposure to asbestos fibers. Soil collected from the parking lot contained trace levels of tremolite and chrysotile asbestos [36,37,38]. No information is available concerning the level of asbestos fibers suspended from the parking lot in dust; however, it has been shown that disturbing soils that contain trace levels of asbestos can result in suspended fibers at levels of concern [45].

Paths and other bare areas on campus

In the past, pedestrian traffic in bare areas on the campus probably caused exposure to asbestos fibers. Several soil samples from bare areas on the campus contained greater than 1% asbestos

(samples contained actinolite, anthophyllite, and chrysotile forms of asbestos). No information is available concerning the level of asbestos fibers suspended from bare areas in dust; however, it has been shown that disturbing soils containing even trace levels (less than 1%) of asbestos can result in suspended fibers at levels of concern [45].

Estimation of Potential Past Exposures

The past data available are limited and insufficient to allow adequate estimation of past exposures. However, to answer questions posed by the public about the implications of potential past exposures, ATSDR used professional judgment and the limited past data available to obtain very rough estimates of potential past exposures and the resulting risk. The estimates described in the following sections are uncertain because of the limited data and the many unknowns involved.

ATSDR evaluated a number of exposure scenarios for Oak Ridge High School. Table 1 presents for each exposure scenario the population of interest, the assumed exposure duration in years, and the fraction of time that exposure was assumed to occur through the identified exposure pathways.

Table 1. Exposure Duration Assumptions for the Exposure Scenarios Evaluated

Exposure Scenario/Population of Interest	Exposure Duration in Years	Exposure Pathway				
		Sports Activities	Classrooms	Dirt Parking Lot	Paths & Bare Areas	Sports Spectator Stands
Coaches	15	6 hr/day 7 days/wk	3 hr/day 5 days/wk	½ hr/day 7 days/wk	½ hr/day 5 days/wk	-
Outdoor Maintenance Staff	15	7 hr/day 5 days/wk	-	½ hr/day 5 days/wk	½ hr/day 5 days/wk	3 hr/day 2 days/wk
Student Athletes	4	3 hr/day 7 days/wk	6 hr/day 5 days/wk	½ hr/day 7 days/wk	½ hr/day 5 days/wk	-
Teachers (no coaching)	15	-	9 hr/day 5 days/wk	½ hr/day 5 days/wk	½ hr/day 5 days/wk	3 hr/day 2 days/wk
Indoor Cleaning Staff	15	-	7 hr/day 5 days/wk	½ hr/day 5 days/wk	½ hr/day 5 days/wk	3 hr/day 2 days/wk
Students (not athletes)	4	1 hr/day 5 days/wk	6 hr/day 5 days/wk	½ hr/day 5 days/wk	½ hr/day 5 days/wk	3 hr/day 2 days/wk
Parents of Athletes	4	2 hr/day 1 day/wk	-	½ hr/day 1 day/wk	-	3 hr/day 2 days/wk
Loyal Sports Spectators	15	-	-	-	-	3 hr/day 2 days/wk

Next, for each exposure pathway, ATSDR determined an “assumed asbestos fiber concentration,” defined as the concentration of amphibole asbestos that might be inhaled during the assumed time of exposure. The assumed fiber concentrations and the rationale for choosing them are listed in Table 2. It should be noted that although ATSDR in general selected the highest appropriate concentration as a protective “worst case” estimate, the limited nature of the available data leave open the possibility that concentrations present in actual exposures could have been significantly higher (or lower).

Table 2. Assumed Asbestos Fiber Concentration for Each Exposure Pathway Evaluated

Exposure Pathway	Assumed Fiber Concentration, f/cc	Rationale
Sports Activities	0.1023	Highest value measured in athletic field activity-based monitoring [35]. (Other values measured were similar to this value.)
Classrooms	0.005	Detection limit of only precleaning testing of classrooms available (which showed no detection of asbestos) [24]. It is assumed that some fibers were present prior to cleaning, but only at concentrations below the high detection limit (0.005 f/cc) used.
Dirt Parking Lot	0.1	Assumed to be similar to values measured in athletic field activity-based monitoring [35].
Paths and Bare Areas	0.01	Assumed to be similar to values measured in area monitors around athletic fields in activity-based monitoring [35].
Sports Spectators	0.0097	Highest value measured in area monitors around athletic field activity-based monitoring [35].

Next, for each exposure scenario, ATSDR estimated the cumulative average fiber concentration for all the exposure pathways using the exposure assumptions listed in Table 1. The fiber concentration was averaged over a 70-year lifetime to allow estimation of cancer risks based on a lifetime of exposure. The formula used to calculate the average fiber concentration over a lifetime is as follows:

$$\text{Avg fiber conc.} \left(\frac{f}{cc} \right) = \sum_i \left(\text{fiber conc for pathway } i \times \frac{\text{hr / day}}{24 \text{ hr / day}} \times \frac{\text{days / wk}}{7 \text{ days / wk}} \times \frac{\text{yr duration}}{70 - \text{yr lifetime}} \right)$$

Using this formula, ATSDR calculated lifetime average fiber concentrations for exposures for the various scenarios evaluated. These concentrations, which only include the estimated exposures that would have taken place at the Oak Ridge High School campus, are presented in Table 3.

Table 3. Estimated Average Fiber Concentration Over a 70-Year Lifetime

Exposure Scenario	Average Lifetime Fiber Concentration From All Pathways, f/cc
Coaches	0.006
Outdoor Maintenance Staff	0.005
Student Athletes	0.0009
Teachers (no coaching)	0.0007
Indoor Cleaning Staff	0.0007
Students (not athletes)	0.0003
Parents of Athletes	0.0001
Loyal Sports Spectators	0.00007

Estimation of Risk from Potential Past Exposures

ATSDR used EPA's asbestos risk model, developed in 1986, to estimate risks posed by past exposures at Oak Ridge High School. The 1986 EPA risk model uses a single slope factor which, when multiplied by the lifetime average asbestos fiber exposure, predicts the increased risk of developing cancer (lung cancer and mesothelioma). EPA generally uses an acceptable risk range of 1 additional cancer out of 1,000,000 to 1 out of 10,000 in its risk assessments. Table 4 qualitatively compares the cancer risk estimated using the EPA 1986 risk model with the highest acceptable risk in this range, 1 in 10,000.

Table 4. Estimated Additional Lifetime Cancer Risk for Exposure Scenarios Evaluated

Exposure Scenario (Based on assumptions and estimates listed in Tables 1–3)	Additional Lifetime Cancer Risk
Coaches	Greater than 1 in 10,000
Outdoor Maintenance Staff	Greater than 1 in 10,000
Student Athletes	Greater than 1 in 10,000
Teachers (no coaching)	About 1 in 10,000
Indoor Cleaning Staff	About 1 in 10,000
Students (not athletes)	About 1 in 10,000
Parents of Athletes	Much less than 1 in 10,000
Loyal Sports Spectators	Much less than 1 in 10,000

ATSDR presents the results without specific numbers because a number of disadvantages exist to using the 1986 asbestos risk model for this situation. The model assumes equal toxicity of amphibole and chrysotile asbestos and does not account for the greater risk posed by longer fibers. The use of this model likely **underestimates** risk because the fibrous amphibole asbestos found at the school poses an increased risk for disease, especially for mesothelioma. As an alternative to the 1986 asbestos risk model, Berman and Crump developed a model that accounts for both the greater toxicity of amphibole fibers and the greater potency of longer fibers [47,48,49]. However, information about the size distribution of detected fibers at Oak Ridge High School was inadequate, and the Berman and Crump model results are highly dependent on the size distribution. For these reasons, the Berman and Crump model could not be used to predict increased risk of cancer from estimated past exposures at Oak Ridge High School. Although the EPA 1986 model is very limited in this situation, it gives a qualitative indication that risk from potential past exposures could be of concern.

Uncertainties

ATSDR used the available data to reach general conclusions about likely exposures and to obtain a general sense of the risk of health effects that could result from exposures. The conclusions reached are uncertain, however, because of several factors discussed in the following section:

- **Lack of Representative Data**—Data representing actual past conditions at the school were very limited, and assumptions made about applicability of the available data may be inaccurate. Actual asbestos levels at the school in the past may have been either higher or lower than levels detected in the sampling.

- **Analysis Method**—Various analytical methods were used, and the dimensions of fibers either detected or counted may not correspond to those thought to be toxicologically relevant. In some cases, the minimum detection limit or minimum reporting limit was too high to allow accurate measurement of low levels of asbestos. The detection limits are in some cases higher than levels of concern.
- **Use of EPA 1986 Risk Model**—The 1986 EPA risk model fails to account for the greater potency of amphibole asbestos and does not consider longer fibers to be more potent, but both of these points are generally accepted today. ATSDR's use of the EPA model was necessitated by limited data that prevented application of more appropriate models.
- **Exposure Scenario Assumptions**—Intensity and duration of exposure may have varied from the assumptions made in this evaluation.
- **Off-Campus Exposures**—Amphibole asbestos occurs throughout the area of California where Oak Ridge High School is located. CARB has performed ambient air monitoring in several locations in El Dorado County and detected low levels of amphibole asbestos fibers. Because activities generally result in exposure to levels of asbestos higher than those detected in static monitoring, activities that take place in other areas could contribute to the overall exposure that students and staff may have experienced.

Health Outcome Data

ATSDR was asked to evaluate health outcome data (specifically, mesothelioma incidence rates) for the area around Oak Ridge High School. In some instances, health outcome data can be used to give a more thorough evaluation of the public health implications of a given exposure. In this case, health outcome data cannot be effectively used to evaluate the high school because: (1) the potentially exposed population at the school is small in relation to census-tract-level data in the regional health outcome database, making a meaningful comparison of disease rates difficult; (2) most of the exposures have occurred recently in relation to the latency of disease progression; and (3) potentially exposed students or staff who may have moved away would not be included in the database.

Because the community requested information on mesothelioma incidence rates in the area, though, ATSDR requested mesothelioma data for western El Dorado County from the California Cancer Surveillance Program. A summary of the information that the California Cancer Surveillance Program provided is included in Appendix C of this health consultation. No difference was found between observed and expected rates of mesothelioma incidence for the years 1988-2001.

In general, asbestos-related illness takes many decades to develop after significant exposure. This characteristic is called latency. Detection of asbestos-related illness caused by environmental exposure would take many decades. El Dorado County is growing rapidly. The population in the area around Oak Ridge High School has doubled about every 10 years since the school was built. Therefore, detecting an increase, if any, in asbestos-related illness in the state cancer registry from relatively recent increases in asbestos exposure would be very difficult. Although the state cancer registry does not currently report an apparent increase in mesothelioma rates in the area, the future mesothelioma rates cannot be predicted on the basis of the available environmental data collected.

A recently published epidemiological study reports that mesothelioma incidence (residence at diagnosis) in California correlated with distance to ultramafic rocks, which can contain asbestos [53]. While not unequivocal, the findings suggest the need for further study on health effects resulting from residential exposures to asbestos in California.

Child Health Considerations

ATSDR recognizes that infants and children might be more vulnerable than adults to exposure in communities faced with environmental contamination. Because children depend on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interests at the site. The effects of asbestos on children are thought to be similar to the effects on adults. However, children could be especially vulnerable to asbestos exposures because they are more likely to disturb fiber-laden soil or indoor dust while playing, and they are closer to the ground and thus more likely to inhale contaminated soil or dust. In addition, children have a higher risk of developing disease after asbestos exposure because they have a longer life expectancy and thus more time to develop asbestos-related respiratory diseases, which have long latency periods between exposure and onset of disease.

Teenagers who attended Oak Ridge High School and regularly participated in on-campus sports activities are the most likely students to have been exposed to elevated levels of asbestos. Smaller children who might have accompanied their siblings to practice, for example, could also have been exposed if they played in contaminated soil.

Conclusions

- Exposures to amphibole asbestos probably occurred in the past. The greatest exposures were likely experienced by coaches who spent lots of time on athletic fields and tracks, outdoor maintenance staff, and student athletes.
- Past exposure to amphibole asbestos increases the risk of developing mesothelioma and other lung diseases. Not enough information exists to accurately calculate this risk. Groups who had the highest exposures would have more risk of developing asbestos-related disease. The increased level of risk does not necessarily mean that disease will result.
- Current exposures to asbestos from campus soil at Oak Ridge High School have been minimized by the mitigations conducted by EDUHSD and US EPA.
- A potential for current or future exposure to asbestos that may be tracked in from unmitigated soils on or off campus exists.
- Studies on the prevalence and magnitude of amphibole asbestos exposures outside of Oak Ridge High School will provide information essential for determining the risk of developing asbestos-related disease in community members as a whole.

Recommendations

- The school district should implement the O&M plan as approved by DTSC to minimize the potential for exposure to asbestos from on-campus soil.
- The school district should identify a subset of 3 to 6 classrooms to do confirmatory sampling to ensure that classrooms remain clean. The clearance criteria recommended is that indoor fiber concentrations are statistically less than or equal to outdoor concentrations as described in the AHERA method. Note that a filter loading of less than 70 s/mm² is not an appropriate value for comparison. This confirmatory sampling should be repeated at least once at a different time of the year (*i.e.*, once during the wet season and once during the dry season).
- If the above-described sampling shows that classrooms fail the clearance criteria, ATSDR recommends that the school implement appropriate cleaning methods to reduce asbestos concentrations. Recommended cleaning procedures are being developed by ATSDR and DTSC at this time.
- If sampling cannot be completed in the classrooms, the school district should implement regular cleaning procedures as if classrooms were contaminated. Recommended cleaning procedures are being developed by ATSDR and DTSC at this time.
- Because some increased risk of developing asbestos-related disease from past exposures is possible, people in the most highly exposed groups (coaches, outdoor maintenance staff, and student athletes) should inform their physician about their potential asbestos exposure so that their physician can offer appropriate preventive care and watch for early signs of disease. If the time since first exposure is greater than 10 years (the minimum latency for asbestos-related lung changes), or symptoms of respiratory disease are present, the physician may recommend persons in these groups consult with a specialist who has expertise in asbestos-related disease. ATSDR physicians are available to provide advice to individuals' private physicians, if requested, and are developing outreach programs to educate local health care providers about asbestos-related disease.
- The state should continue to monitor health outcome data for asbestos-related disease.
- ATSDR should investigate the potential for amphibole asbestos exposure in the community as a whole and use this information to study the link between low level environmental exposures and resulting health effects in communities.
- The El Dorado County Air Quality Management District should ensure full enforcement of state and county air toxics regulations to minimize potential asbestos exposures in the community.
- Homeowners should follow local and state recommendations for minimizing asbestos exposure around the home.

Public Health Action Plan

The public health action plan for Oak Ridge High School contains a description of actions that will be taken by ATSDR and/or other government agencies at the site. The purpose of the public health action plan is to ensure not only that public health hazards are identified but that a plan of action is designed to mitigate and prevent adverse human health effects resulting from exposure

to hazardous substances in the environment. ATSDR is committed to following up on the plan to ensure its implementation. The following is a list of public health actions to be implemented.

- ATSDR will evaluate EPA data being collected and use it with an asbestos risk model that accounts for mineralogy and fiber dimensions to assess risks of amphibole exposure at Oak Ridge High School and other nearby areas with naturally occurring asbestos.
- ATSDR will use this information to evaluate the necessity and feasibility of conducting appropriate health studies for Oak Ridge High School and the community.
- ATSDR will also evaluate the necessity and feasibility of maintaining a registry to track potentially exposed people in the area.
- ATSDR will provide information and recommendations to the community and health care providers on asbestos-related disease.
- ATSDR will collect and analyze community-level data (i.e., individual concerns, questions, and news media content) and provide community education as indicated.
- ATSDR will work with DTSC to develop procedures for appropriate cleaning methods.

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Appendix A. Peer Review Comments and Responses

Many issues in asbestos science today are debated among scientists. ATSDR requested a draft of this public health consultation be “peer reviewed” to ensure that the evaluation performed in the document was done using the best science given the nature of the available information. The public health consultation was peer reviewed by three asbestos science experts who have no affiliation with ATSDR and are listed below. This appendix contains the questions posed to the peer reviewers, their comments (verbatim), and ATSDR’s responses to the comments.

Peer reviewers:

Morton Lippmann, PhD
Professor
Department of Environmental Medicine
School of Medicine
New York University

Philip Harber, MD, MPH
Professor of Family Medicine
Vice Chair-Academic Affairs
Chief, Division of Occupational and Environmental Medicine
University of California, Los Angeles

John (Jack) Parker, MD, FCCP, FACP
Section Chief
Pulmonary & Critical Care Medicine Section
Department of Medicine
West Virginia University

1. Does the public health consultation adequately describe potential past and present pathways of human exposure to asbestos at Oak Ridge High School?

[Comments from Dr. Lippmann]:

Yes.

[Comments from Dr. Harber]:

Yes.

[Comments from Dr. Parker]:

Yes. Elegant exposure estimates.

2. Are the available data adequate and is the data evaluation appropriate for the estimation of potential past exposures and determination of potential health hazard(s)?

[Comments from Dr. Lippmann]:

The data are relatively rich for such an evaluation of public health risks of community level asbestos exposures, but the analyses were flawed by the nature of some of the assumptions made that led to serious overestimation of the health risks. Specifically, these assumptions were:

- 1) that fiber counts in f/cc and s/cc can be used interchangeably. TEM analyses following AHERA procedures count all fibers longer than 0.5 μm , and the fiber counts between these two limits almost always greatly exceed the longer ones. Table 2 mislabels s/cc levels as f/cc levels.

Response from ATSDR: *Using the count of total structures instead of the count of structures greater than 5 μm in length will overestimate risk, but this overestimation is not significant, especially in light of the uncertainties with the sampling. The raw data sheets for the activity-based sampling reported structures less than and greater than 5 μm in length. In general, structures greater than 5 μm in length contributed 50% or more to the total structure count. Therefore, estimating exposure using the total structure count would give estimates within the same order of magnitude as estimates made using the longer structures. In addition, the raw data sheets identified the mineralogy and characteristics of reported structures. All structures contributing to the total structure count were asbestos fibers. Therefore, for the qualitative analysis performed in the health consultation, it is a reasonable approximation to use reported s/cc counts interchangeably with f/cc counts. Table 2 lists the fiber concentrations assumed in the exposure estimates, so the concentrations are listed as f/cc although the assumed values were based on reported s/cc measurements.*

ATSDR has added clarifying information on this subject to the text of the health consultation, beginning on page 5.

- 2) That fiber counts collected under “aggressive sampling” protocols, i.e., with a leaf blower agitating surfaces can realistically represent people’s exposures in situations where the exposure of interest for risk estimation is long-term average exposure.

Response from ATSDR: *Samples collected using a leaf blower were not used in any of the exposure estimates. For classrooms, it was assumed that fibers were present at the detection limit of past sampling, 0.005 f/cc. Asbestos exposure in classrooms was not a major contributor to estimated exposures of the highly exposed groups. For all other areas of campus, the assumed fiber concentrations used to estimate exposures were based on results of activity-based samples collected during representative activities that are typically performed in those areas.*

- 3) That it is appropriate to use the highest measured value (e.g., 0.1023 s/cc for Sports Activities in Table 2) as a f/cc value, and especially as one used as a long-term exposure value in the risk assessment.

Response from ATSDR: *The activity-based sampling was performed in a few locations over a limited time period. It is not certain whether the results truly represent levels of asbestos to which students and staff might actually have been exposed over the course of their activities at the school. Actual exposures could have been higher or lower. The use of the highest measured value was considered to be appropriately conservative. This value was not, however, used as a long-term exposure value. The value was corrected in such a way as to make it analogous to a time-weighted average. Although the assumed linearity of response is not appropriate for mesothelioma, ATSDR was unable to use the most appropriate models because of limitations in the data. The linear extrapolation does provide a reasonable qualitative estimate of risk. As described the health consultation, for each scenario evaluated, ATSDR combined the assumed fiber value for each activity (Table 2) with the assumed duration and frequency of activities (Table 1) to estimate an average long-term exposure. For all other times outside the described activities, a zero exposure was assumed—an assumption that could be untrue given the presence of natural asbestos deposits in the area.*

A more even-handed interpretation of the relatively rich air concentration database would provide a much more realistic health assessment, and one that could ease the public health concerns of the community.

Response from ATSDR: *The findings, while qualitative, are realistic and balanced. Although the exposure estimates may be relatively conservative, the uncertainty in the available data set warrants a conservative approach. Using the EPA 1986 risk model may well underestimate the risk of past exposure to the amphibole fibers seen at Oak Ridge High School. Community public health concerns would best be addressed by taking appropriate measures to reduce the chance of further exposures, such as has been done with mitigation activities.*

[Comments from Dr. Harber]:

The risk assessment approach is generally reasonable, particularly in view of the inherent uncertainties. The experts may wish to consider the following comments:

Since mesothelioma is the primary concern, considering the two classes of asbestos as equivalent may underestimate the risk in view of the high amphibole %.

Response from ATSDR: *ATSDR agrees that the risk model used may significantly underestimate risk posed by amphibole asbestos for mesothelioma.*

The impact of exposures early in life may be greater than exposures later in life for several reasons: First, early life exposures have a longer time to take an effect (appropriately discussed in the document). Second, the "slope factor" for early life exposures may be different from that later in life (either because airway geometry increases the deposition

fraction or more fundamental biologic reasons). Third, the "force of mortality" (likelihood of death from another cause) is considerably lower for school age children than for older adults, potentially magnifying the impact of school related exposures.

Response from ATSDR: *ATSDR agrees that children's exposures to asbestos may pose a greater risk than adults' exposures and that our approach of extrapolating exposure to an average lifetime exposure may slightly underestimate risk for mesothelioma when exposure occurs in early life stages. This effect is magnified for the very young. However, Oak Ridge High School's students are aged 14 to 18 years old, and physiological differences (increased breathing rate, etc.) are not as great for this age group compared with very young children. Also, the "force of mortality" reflected in the life tables for 14- to 18-year-olds is closer to that of adults than to that of very young children. Given the qualitative nature of the evaluation, averaging the exposure over a lifetime does not introduce undue uncertainty. Part of the reason ATSDR has used a conservative estimate of exposure is the uncertainty introduced by early life exposures. New methods are available that better estimate the risk from short-term and early life exposures, but the air sampling and fiber analysis must be performed in a manner that was unavailable when the data in this data set were obtained.*

The risk calculation model includes several multiplier terms that decrease the exposure risk according to the percentage of time of exposure in comparison to the reference full life exposure (i.e., hours/ day, weeks/ year, years/lifetime). For short exposures such as those encountered here, this proportional decreasing of the risk is a very significant factor. One must assure that the reference lifetime studies lowered doses in the same way (i.e., that it did not assume 24 hrs daily exposure). Further, use of lifetime cumulative exposure risk as the reference reduces the impact of more recent exposures; that is not true for early life exposures (i.e., 4 fiber years accumulated over 40 years includes one fiber year in the most recent 10 years, unlikely to be significant due to the minimum latency. Conversely, 4 fiber years accumulated very early and evaluated later in life has no discounting effect for recent exposures).

Response from ATSDR: *The inability to predict risks from occasional short term exposures is an inherent problem of the risk models in use today. The mesothelioma model is of particular concern because it is more dependent upon time since first exposure than upon exposure duration at later times. Averaging exposure over a lifetime does discount the last 10 years of exposure because both the lung cancer and mesothelioma models are lagged by 10 years to account for disease latency. However, although averaging an acute early life exposure over a lifetime underestimates the risk, such a method still accounts for more than 85% (60 out of 70 years) of the exposure. In light of the other uncertainties detailed in the health consultation, the conservative risk assumptions, and the qualitative nature of the risk assessment, the calculated risk is reasonable.*

[Comments from Dr. Parker]:

Yes.

3. Does the public health consultation adequately describe uncertainties associated with the evaluation of health risks from estimated potential past exposures?

[Comments from Dr. Lippmann]:

All of the uncertainties are well described. Thus it was disturbing that worst case interpretations of them, rather than more balanced interpretations, were used in estimating risks.

Response from ATSDR: *ATSDR generally uses conservative assumptions when many uncertainties exist in order to be protective of public health. ATSDR recognizes Dr. Lippmann's concerns about the conservative nature of the exposure assumptions; however, ATSDR also recognizes the nonconservative approaches of current asbestos risk models, especially when those models are used to evaluate the risk posed by amphibole fibers. This consultation's findings indicate that groups that were highly exposed to asbestos at the school might have an increased risk of developing disease and that minimizing chances for further exposures is warranted. The findings of this consultation do not mean that all (or any) members of exposed groups will develop asbestos-related disease.*

[Comments from Dr. Harber]:

Yes.

[Comments from Dr. Parker]:

Yes.

4. Does the public health consultation adequately describe what is known about the relationship between asbestos exposure levels and potential health effects?

[Comments from Dr. Lippmann]:

The answer would be yes, if the word "levels" was omitted, or "levels" referred to actual levels rather than those used in the risk assessment part of the document..

Response from ATSDR: *ATSDR considers the levels of asbestos measured during activity-based sampling to be representative of actual levels of exposure during those activities. As stated earlier, ATSDR used a time-weighted approach to correct activity-based sampling results to average levels for computing lifetime risks.*

[Comments from Dr. Harber]:

- The section dealing with fiber sampling techniques is well written and communicates the difficulty interchanging results from the several methods. The discussion of work or exposures in terms of "structures" may, however, be misunderstood in the context of workers' exposure (i.e., worker exposure is still commonly considered using optical methods because of the current OSHA standards). Workers interpreting exposures expressed in "structures" might misunderstand. Perhaps the Agency may wish to consider adding a very explicit statement that structures cannot be directly interchanged into the fibers per cc as used in OSHA standards.

Response from ATSDR: *In general, fiber counts as determined using PCM (counting fibers longer than 5 μm and with aspect ratios greater than 3:1) are not directly interchangeable with counts of structures determined using AHERA counting rules with TEM (structures greater than 0.5 μm in length and with aspect ratios greater than 3:1). However, as described previously in response to Dr. Lippmann's comment, for the qualitative analysis performed in this health consultation, it is a reasonable approximation to use reported s/cc counts interchangeably with f/cc counts. The TEM raw data sheets for the activity-based sampling reported structures less than and greater than 5 μm in length. In general, structures greater than 5 μm in length contributed 50% or more to the total structure count. Therefore, estimating exposure using the total structure count would give estimates within the same order of magnitude as using the longer structures. In addition, the raw data sheets identified the mineralogy and characteristics of reported structures. All structures contributing to the total structure count were asbestos fibers (as opposed to clusters, bundles, or cleavage fragments). Therefore, it was a reasonable approximation to use s/cc and f/cc interchangeably in this instance.*

ATSDR has added clarifying information on this subject to the text of the health consultation, beginning on page 5.

- The Asbestos Background section suggests that fiber types are interchangeable. The assumption that "natural" asbestos is equivalent to "commercial" asbestos may lead to overestimating the risk- some studies have shown that miners have lower unit risk than those who work with the commercial products, probably because the preparation of the commercial products splits asbestos into higher aspect ratio fibers. Conversely, as suggested below, risk may be underestimated here because of the high proportion of amphibole asbestos.

Response from ATSDR: *What ATSDR meant is that a fiber of a specific size, shape, and mineralogy, after it is suspended in air, has the same risk regardless of whether it was suspended from natural deposits in soil or from a commercially manufactured product. The size, shape, and mineralogy of a fiber are important determinants of risk, which is why ATSDR would prefer to use risk models that account for these factors. ATSDR has rewritten the statement on page 2 to clarify this point.*

- In the Asbestos Health Effects section, there may be two small typographical errors. The "pleural thickening" might better be termed "diffuse pleural thickening" to differentiate more clearly from localized plaque. Later, it discusses "symptoms such as loss of lung function"; technically, a symptom is something reported by a patient/person, whereas loss of lung function is a "sign" not something that the person reports.

Response from ATSDR: *The suggested changes were made.*

[Comments from Dr. Parker]:

Yes.

5. Does the public health assessment accurately and clearly communicate the health hazard(s) posed by asbestos at Oak Ridge High School?

[Comments from Dr. Lippmann]:

Not accurately, for the reasons stated above. The wording is clear.

[Comments from Dr. Harber]:

Yes!

- The Agency should decide if it wishes to strengthen the section about community based exposures. Although the focus is on the particular school, presumably community members may face similar risks if they significantly disturb the soil in their homes. Inclusion of such a cautionary statement in this document may help public health education in the community and may represent an opportunity for improving dissemination of objective, rational, scientifically valid information for the community

Response from ATSDR: *Other asbestos exposures in the community could be adding to the risk from exposures at Oak Ridge High School. To provide a more timely response to the petitioner, ATSDR elected to evaluate Oak Ridge High School independently of other exposures. ATSDR will evaluate community exposures in another health consultation to be released later this year. It would be prudent for people who live in the community to take steps to minimize their potential exposure to asbestos.*

- In view of the high proportion of Spanish speaking persons in CA, the Agency may wish to consider translation into Spanish. (Even if not necessary for the school students and current employees, doing this may serve the needs of those who will refer to the document in the future. Indeed, persons at greatest risk of the effects of soil exposure by virtue of working with construction, landscaping, etc. may be particularly likely to benefit from a translated version)

Response from ATSDR: *ATSDR will translate fact sheets developed summarizing the findings of this health consultation into Spanish. ATSDR will work with the community to determine effective ways of communicating the findings to the general public.*

[Comments from Dr. Parker]:

Yes.

6. Are the conclusions and recommendations appropriate in view of the potential past and present exposures as described in the public health consultation?

[Comments from Dr. Lippmann]:

The conclusions are appropriate, and well stated.

Recommendations 1, 3, 4, and 5 are appropriate. However recommendation #2 should be restated. Based on the objective evidence presented, the risks of cumulative past exposures are so low that clinically detectable evidence of measurable effects is extremely small. It is

therefore not clear what benefits would derive from encouraging residents to seek physician consultations.

Response from ATSDR: *The original recommendation was worded to indicate that people in highly exposed groups who are concerned about their exposure or who exhibit signs of respiratory disease should consult with a specialist. ATSDR clarified this recommendation to indicate that persons in the highly exposed groups should inform their physician about their potential asbestos exposure. The physician might recommend consulting with a specialist if more than 10 years have passed since the first exposure or if respiratory symptoms are present. Although the exact levels of past exposure cannot be known with certainty, ATSDR concluded that highly exposed groups could have an increased risk of disease. A person's physician should know about any history of potential asbestos exposure so that he or she can offer appropriate preventive care and watch for early signs of disease.*

[Comments from Dr. Harber]:

These are clear and reasonable.

- Please consider strengthening the recommendations regarding the need for ongoing efforts to prevent recurrence of construction or other activities disturbing the soil. (eg, perhaps a more explicit discussion of the requirement for the school board to take direct responsibility for assuring that those responsible for maintenance and facilities always understand the implications of the asbestos in the soil).

Response from ATSDR: *ATSDR was asked to review and comment on the school board's operations and maintenance plan*. ATSDR considers the plan to be protective of public health. It was ATSDR's intent to refer to that plan and not restate it in this document.*

- The document might include recommendation for posting signs, issuing notices to the community/ advisory committees on a regular ongoing basis, etc. (Over time, institutions and communities tend to forget matters that had been highly visible in the past) Including such recommendations can help assure the community that "this will not happen again" .

* ATSDR reviewed a draft operations and maintenance (O&M) plan prepared for the EDUHSC. At that time, ATSDR concluded that the O&M plan provided adequate controls to prevent future exposures. Since then, at the request of the EDUHSD, DTSC's School Property Evaluation and Cleanup Division entered into an agreement with the district to review and approve the O&M Plan for Oak Ridge High School. The revised O&M Plan establishes EDUHSD's policy for managing naturally occurring asbestos on the school campus [46]. The primary objective of the current plan is to ensure the integrity of the cap and prevent exposures to soils laying beneath the cap. The plan does not address or consider potential exposure from unmitigated areas, from off-campus track-in, or from other off-campus sources.

ATSDR has reviewed the new O&M plan and submitted comments to DTSC on January 3, 2006. DTSC has agreed with the comments made by ATSDR and is currently working with EDUHSD to amend the agreement to include the changes. Because the new plan does not include steps ATSDR considers vital to limiting exposures in the future, recommendations for monitoring and/or cleaning school classrooms were added to the recommendations section of this document.

Response from ATSDR: *Because the potential for asbestos exposures at the school has been mitigated, warning signs and notices are not necessary there. ATSDR will consider this recommendation when evaluating asbestos exposures at other areas in the community, not all of which may be mitigated.*

- Previously exposed individuals are referred to their personal physicians. There is limited specific guidance provided, however; unfortunately, many primary care physicians may not have adequate understanding to differentiate low-level from high level exposure and might mislead patients.

Response from ATSDR: *ATSDR recommends that people who were in the most highly exposed groups inform their personal physician about their potential asbestos exposure. ATSDR is developing outreach programs and educational materials targeted to local health care providers that will give more specific guidance on diagnosing and treating asbestos-related disease.*

- Statements about future risk are valid only if there are no repeats of the construction related exposures. (As discussed elsewhere, this is an assumption, not a definite reality)

Response from ATSDR: *This is true; however, no further construction related exposures should occur at Oak Ridge High School if an appropriate operations and maintenance plan is followed.*

[Comments from Dr. Parker]:

Yes. Outstanding report/consultation. This is first rate/ state-of-the-art science.

7. Are there any other comments about the public health consultation that you would like to make?

[Comments from Dr. Lippmann]:

On page 4, paragraph 4, line 8, “Wittenoom” is misspelled.

Response from ATSDR: *The spelling of Wittenoom has been corrected.*

[Comments from Dr. Harber]:

The document discusses a complex topic in a clear, understandable fashion. It also is effective in including reference to other support documents.

[Comments from Dr. Parker]:

No. Solid work, well supported.

8. Are there any comments on NCEH/ATSDR's peer review process?

[Comments from Dr. Harber]:

The process seems to be appropriate.

9. Are there any other comments?

[Comments from Dr. Harber]:

The above comments are purely suggestions for consideration. The document was clearly prepared with a great deal of thought and insight by many experts. Furthermore, the Agency staff have undoubtedly interacted with the affected community and is in a better position to assess appropriate communication styles than I am looking only at a paper document. Thank you for the opportunity to participate in this process.

Response from ATSDR: *ATSDR appreciates the comments and insights of all the peer reviewers.*

Appendix B. Asbestos Overview

Asbestos is a general name applied to a group of silicate minerals consisting of thin, separable fibers in a parallel arrangement. Asbestos minerals fall into two groups, serpentine and amphibole. Serpentine asbestos has relatively long and flexible crystalline fibers; this class includes chrysotile, the predominant type of asbestos used commercially. Amphibole asbestos minerals are brittle and have a rod- or needle-like shape. Amphibole minerals regulated as asbestos by OSHA include five classes: fibrous tremolite, actinolite, anthophyllite, crocidolite, and amosite. However, other amphibole minerals, including winchite, richterite, and others, can exhibit fibrous asbestiform properties [3]. Some soils in the area around the school contain amphibole asbestos. Soil samples collected from the school property contained up to 6% fibrous amphibole asbestos, mostly actinolite. Chrysotile and tremolite asbestos were also detected in some samples.

Asbestos fibers do not have any detectable odor or taste. They do not dissolve in water or evaporate and are resistant to heat, fire, and chemical and biological degradation.

The following sections provide an overview of several concepts relevant to the evaluation of asbestos exposure, including analytical techniques, toxicity and health effects, and current regulations concerning asbestos in the environment.

Methods for Measuring Asbestos Content

A number of different analytical methods are used to evaluate asbestos content in air, soil, and other bulk materials. Each method varies in its ability to measure fiber characteristics such as length, width, and mineral type. For air samples, fiber quantification is traditionally done through phase contrast microscopy (PCM) by counting fibers that are longer than 5 μm and that have an aspect ratio (length:width) greater than 3:1. This is the standard method by which regulatory limits were developed. Disadvantages of this method include the inability to detect fibers thinner than 0.25 μm in diameter and the inability to distinguish between asbestos and non-asbestos fibers [3].

Asbestos content in soil and bulk material samples is commonly determined using polarized light microscopy (PLM), a method that uses polarized light to compare refractive indices of minerals and that can distinguish between asbestos and non-asbestos fibers and between different types of asbestos. The PLM method can detect fibers with lengths greater than $\sim 1 \mu\text{m}$, widths greater than $\sim 0.25 \mu\text{m}$, and aspect ratios (length to width ratios) of greater than 3. Detection limits for PLM methods are typically 0.25–1% asbestos.

Scanning electron microscopy (SEM) and, more commonly, transmission electron microscopy (TEM) are more sensitive methods that can detect smaller fibers than light microscopic techniques. TEM allows the use of electron diffraction and energy-dispersive x-ray methods, which give information on crystal structure and elemental composition, respectively. This information can be used to determine the elemental composition of the visualized fibers. SEM does not allow measurement of electron diffraction patterns. One disadvantage of electron

microscopic methods is that determining asbestos concentration in soils and other bulk materials is difficult [3].

For risk assessment purposes, TEM measurements are sometimes multiplied by conversion factors to give PCM equivalent fiber concentrations. The correlation between PCM fiber counts and TEM mass measurements is very poor. A conversion between TEM mass and PCM fiber count of 30 micrograms per cubic meter per fiber per cubic centimeter [$(\mu\text{g}/\text{m}^3)/(\text{f}/\text{cc})$] was adopted as a conversion factor, but this value is highly uncertain because it represents an average of conversions ranging from 5 to 150 $(\mu\text{g}/\text{m}^3)/(\text{f}/\text{cc})$ [23]. The correlation between PCM fiber counts and TEM fiber counts is also very uncertain, and no generally applicable conversion factor exists for these two measurements [23]. Generally, a combination of PCM and TEM is used to describe the fiber population in a particular air sample.

EPA is currently working with several contract laboratories and other organizations to develop, refine, and test a number of methods for screening bulk soil samples. The methods under investigation include PLM, infrared (IR), and SEM (personal communication, Jim Christiansen, U.S. Environmental Protection Agency, November 2002).

Asbestos Health Effects and Toxicity

Breathing any type of asbestos increases the risk of the following health effects.

Malignant mesothelioma—Cancer of the membrane lining the chest cavity and covering the lungs (pleura) or lining the abdominal cavity (peritoneum). This cancer can spread to tissues surrounding the lungs or other organs. The great majority of mesothelioma cases are attributable to asbestos exposure [3]. Many scientists believe that amphibole asbestos fibers have as much as 100 times the potency for causing mesothelioma as chrysotile fibers, mainly because of increased persistence of amphiboles in the lungs.

Lung cancer—Cancer of the lung tissue, also known as bronchogenic carcinoma. The exact mechanism relating asbestos exposure with lung cancer is not completely understood. The combination of tobacco smoking and asbestos exposure greatly increases the risk of developing lung cancer [3].

Noncancer effects—These include *asbestosis*, a restrictive lung disease caused by asbestos fibers scarring the lung; *pleural plaques*, localized areas of thickening of the pleura; *diffuse pleural thickening*, generalized thickening of the pleura; *pleural calcification*, calcium deposition on pleural areas thickened from chronic inflammation and scarring; and *pleural effusions*, fluid buildup in the pleural space between the lungs and the chest cavity [3].

Weak evidence exists that inhalation of asbestos may increase the risk of cancer in the gastrointestinal tract (because of swallowing of fibers removed from the lung by mucociliary transport). However, the studies are conflicting and show a much weaker effect than that proven for cancers of the lungs, pleura, or peritoneum [3].

Ingestion of asbestos causes little or no risk of noncancer effects. However, some evidence exists that acute oral exposure might induce precursor lesions of colon cancer and that chronic oral exposure might lead to an increased risk of gastrointestinal tumors [3]. Dermal exposure to asbestos is associated with the formation of small warts or corns, particularly on the hands.

ATSDR considers the inhalation route of exposure to be the most significant in the current evaluation of Oak Ridge High School. Actions taken to limit inhalation exposures will minimize risk from dermal and oral exposures as well.

The risk of health effects from breathing in asbestos increases with the concentration of fibers inhaled, with how often and how long the fibers are inhaled, and with the length of time since the first exposure occurred. Asbestos-related lung disease has been identified in several communities around the world that have naturally occurring asbestos, including areas of Greece, Turkey, Corsica, Italy, Sicily, Cyprus, China, and New Caledonia [3–16]. Similarly, disease associated with environmental-level exposures has been identified in people living near mines or processing operations for asbestos or asbestos-containing minerals, such as in Libby, Montana, or in Wittenoom, western Australia [17,18]. However, little information exists on the exact levels of asbestos exposure experienced by these communities, and exposure characteristics might differ significantly from other areas where environmental exposures are possible. It is not possible to extrapolate these findings to other areas in an attempt to predict the likelihood of disease.

The scientific community generally accepts the correlations of asbestos toxicity with fiber length as well as fiber mineralogy. Fiber length may play an important role in clearance, and mineralogy may affect both biopersistence and surface chemistry.

ATSDR, responding to concerns about asbestos fiber toxicity from the World Trade Center disaster, held an expert panel meeting in December 2002 to review issues regarding fiber size and its role in fiber toxicity [54]. The panel concluded that fiber length plays an important role in toxicity. Fibers with lengths less than 5 μm are essentially nontoxic in terms of association with mesothelioma or lung cancer promotion. However, fibers less than 5 μm in length may play a role in asbestosis when exposure duration is long and fiber concentrations are high. More information is needed to definitively reach this conclusion.

In accordance with these concepts, it has been suggested that amphibole asbestos is more toxic than chrysotile asbestos, mainly because physical differences allow chrysotile to break down and to be cleared from the lung, whereas amphibole is not removed and builds up to high levels in lung tissue [55]. Some researchers believe the resulting increased duration of exposure to amphibole asbestos significantly increases the risk of mesothelioma and, to a lesser extent, asbestosis and lung cancer [55]. However, OSHA continues to regulate chrysotile and amphibole asbestos as one substance, because both types increase the risk of disease [56]. EPA's Integrated Risk Information System (IRIS) assessment of asbestos also treats mineralogy (and fiber length) as equipotent [23].

Evidence suggesting that the different types of asbestos fibers vary in carcinogenic potency and site specificity is limited by the lack of information on fiber exposure by mineral type. Other data

indicate that differences in fiber size distribution and other process differences can contribute at least as much to the observed variation in risk [47].

Counting fibers using the regulatory definitions (see below) does not adequately describe risk of health effects. Fiber size, shape, and composition contribute collectively to risks in ways that are still being elucidated. For example, shorter fibers appear to deposit preferentially in the deep lung, but longer fibers may disproportionately increase the risk of mesothelioma [3,47]. Some of the unregulated amphibole minerals can exhibit asbestiform characteristics and contribute to risk. Fiber diameters greater than 2–5 μm are considered above the upper limit of respirability (that is, too large to inhale) and thus do not contribute significantly to risk [3,47]. Methods are being developed to assess the risks posed by varying types of asbestos and are currently awaiting peer review [47].

Current Standards, Regulations, and Recommendations for Asbestos

In industrial applications, an asbestos-containing material is defined as any material with greater than 1% bulk concentration of asbestos [57]. It is important to note that 1% is not a health-based level but instead represents the practical detection limit in the 1970s when OSHA regulations were created. Studies have shown that disturbing soils containing less than 1% amphibole asbestos can suspend fibers at levels of health concern [45].

Friable asbestos (asbestos that is crumbly and that can be broken down to suspendable fibers) is listed as a hazardous air pollutant on EPA's Toxics Release Inventory [58]. This classification requires companies that release friable asbestos at concentrations greater than 0.1% to report the release under Section 313 of the Emergency Planning and Community Right-to-Know Act.

OSHA's permissible exposure limit (PEL) is 0.1 f/cc for asbestos fibers with lengths greater than 5 μm and with an aspect ratio (length:width) greater than 3:1, as determined by PCM [18]. This value represents a time-weighted average (TWA) exposure level based on 8 hours a day for a 40-hour work week. In addition, OSHA has defined an "excursion limit," which stipulates that no worker should be exposed in excess of 1 f/cc as averaged over a sampling period of 30 minutes [18]. Historically, the OSHA PEL has steadily decreased from an initial standard of 12 f/cc established in 1971. The PEL levels prior to 1983 were determined on the basis of empirical worker health observations, while the levels set from 1983 forward employed some form of quantitative risk assessment. ATSDR has used the current OSHA PEL of 0.1 f/cc as a reference point for evaluating asbestos inhalation exposure for past workers. ATSDR does not, however, support using the PEL for evaluating exposure of community members, because the PEL is based on a risk level that would be considered unacceptable in nonworker populations.

In response to the World Trade Center disaster in 2001 and an immediate concern about asbestos levels in buildings in the area, the Department of Health and Human Services, EPA, and the Department of Labor formed the Environmental Assessment Working Group. This working group was made up of staff from ATSDR, EPA, CDC's National Center for Environmental Health and National Institute of Occupational Safety and Health (NIOSH), the New York City Department of Health and Mental Hygiene, the New York State Department of Health, OSHA, and other state, local, and private entities. The working group set a reoccupation level of

0.01 f/cc after cleanup. Continued monitoring was also recommended to limit long-term exposure at this level [21].

NIOSH set a recommended exposure limit of 0.1 f/cc for asbestos fibers longer than 5 μm . This limit is a TWA for up to a 10-hour workday in a 40-hour work week [19]. The American Conference of Governmental Industrial Hygienists (ACGIH) has also adopted a TWA of 0.1 f/cc as its threshold limit value [20].

EPA has set a maximum contaminant level (MCL) for asbestos fibers in water of 7,000,000 fibers longer than 10 μm per liter, on the basis of an increased risk of developing benign intestinal polyps [59]. Many states use the same value as a human health water quality standard for surface water and groundwater.

The Asbestos Hazard Emergency Response Act (AHERA), as codified by EPA, contains reference values for clearing schools after asbestos abatement (CFR 763 subpart E). This method allows for the clearance of schools when the indoor air levels of asbestos are not statistically different from outdoor levels or when “as analyzed by the TEM method...for the five air samples does not exceed the filter background level...of 70 structures per square millimeter (70 s/mm²).”

It has been a common practice to “back calculate” the level in air that would be associated with 70 s/mm² and consider that air level as a “safe” air level because it does not exceed the AHERA school standard. It is incorrect to do so. In the past, filters were contaminated with asbestos fibers at an average of 70 s/mm², so a sample that did not yield more than 70 s/mm² could not be distinguished from background contamination. Today filter contamination rates are near zero. On today’s filters, 70 s/mm² would correspond to an unacceptable asbestos air concentration (i.e., would result in adverse health effects) under many conditions. Because of this, AHERA clearance levels should not be used for assessing health effects.

Asbestos is a known human carcinogen. Historically, EPA has calculated an inhalation unit risk for cancer (**cancer slope factor**) of 0.23 per f/cc of asbestos [23]. This value estimates additive risk of lung cancer and mesothelioma using a relative risk model for lung cancer and an absolute risk model for mesothelioma.

This quantitative risk model has significant limitations. First, the unit risks were based on measurements made with PCM and therefore cannot be applied directly to measurements made with other analytical techniques. Second, the unit risk should not be used if the air concentration exceeds 0.04 f/cc, because above this concentration the slope factor might differ from that stated [23]. Perhaps the most significant limitation is that the model does not consider mineralogy, fiber size distribution, or other physical aspects of asbestos toxicity. EPA is in the process of updating its asbestos quantitative risk methodology given the limitations of the current assessment and the knowledge gained since the risk methodology was implemented in 1986.

Appendix C. Mesothelioma Incidence in Western El Dorado County

Health outcome data can be used to give a more thorough evaluation of the public health implications of a given exposure. Health outcome data can include mortality information (for example, the number of people who have died from a certain disease) or morbidity information (for example, the number of people in an area who have a certain disease or illness). The state of California's Cancer Surveillance Program collects information about cancer diagnosed among residents of the state. Cancer cases are reported to the registry by hospitals, doctors, and other facilities.

In 1999, the California Cancer Surveillance Program conducted an evaluation of mesothelioma incidence in western El Dorado County; program staff updated this evaluation in 2004 [50–52]. The census tracts evaluated included the towns of Placerville, Diamond Springs, Pollock Pines, Shingle Springs, Cameron Park, El Dorado Hills, Georgetown, Cool, and Diamond Valley. Between the years of 1988 and 2001, 24 cases of mesothelioma were reported in the census tracts evaluated. The observed number of cases per year (1.714, statistical confidence interval 0.005–7.430) was not significantly different from the expected number of cases per year (1.984 for the Sacramento region). The people who contracted mesothelioma were mostly male, between the ages of 50 to 85 (median age 73), and lived in various locations around the county. The occupation of most of the affected individuals was not identified.

In general, asbestos-related illness takes many decades to develop after significant exposure. This characteristic is called latency. Detection of asbestos-related illness caused by environmental exposure would take many decades. El Dorado County is growing rapidly. The population in the area around Oak Ridge High School has doubled about every 10 years since the school was built. Therefore, detecting an increase, if any, in asbestos-related illness in the state cancer registry from relatively recent increases in asbestos exposure would be very difficult. Although the state cancer registry does not currently report an apparent increase in mesothelioma rates in the area, the future mesothelioma rates cannot be predicted on the basis of the available environmental data collected.

Appendix D. Public Comments Received

This health consultation was available for public review and comment at the Oak Ridge High School Library in El Dorado Hills, California; the El Dorado County Main Library in Placerville, California; the El Dorado County Public Health Department in Placerville, California; and the El Dorado Hills Community Services District offices in El Dorado Hills, California. The public comment period was open from May 6, 2005 through June 20, 2005. The document was also available for viewing or downloading from the ATSDR web site.

The public comment period was announced to local media outlets. ATSDR presented and discussed the findings of the health consultation with community members at a public meeting and availability session on May 6 and 7, 2005, at the Community Services District auditorium in El Dorado Hills, California. Copies of the health consultation and fact sheets summarizing the findings were also provided to the community during these meetings.

The written comments received from organizations and private citizens are listed in their entirety below. ATSDR responses are inserted as italicized text.

D1. Comments from El Dorado Hills Community Group:

Re: Health consultation, Oak Ridge High School, El Dorado Hills, California

Dear Consultation Team:

We write as members of the US EPA-sponsored Community Advisory Group that has been meeting with members of various agencies in connection with our concern about asbestos in El Dorado County, California.

We congratulate you on your Health Consultation dated May 6, 2005. We appreciate the difficulty of drafting this report without benefit of better scientific knowledge than currently exists. As you note in various places in the Consultation, existing knowledge is largely based on exposure to asbestos in commercial products by adults in the workplace. That form of asbestos is largely chrysotile, not the amphibole asbestos of particular concern in El Dorado Hills, which evidence suggests is at least two orders of magnitude more potent (see below).

Although health effects from environmental exposure to asbestos have long been known, there are few quantitative data about exposure levels and effects upon which to draw for this Consultation. Your agency has been compelled to make numerous assumptions in developing your Consultation. We believe you have done this in a thoughtful and conservative way.

At the public meeting in August 2004, you indicated that your consultation would present qualitative, rather than quantitative results. Nevertheless, we think you could have provided more definitive information in your risk analysis. For example, the report indicates the risk of three pathways (coaches, outdoor maintenance staff, and student athletes) is greater than 1 in 10,000. Please specify the actual results of the analysis. Please also acknowledge in the uncertainty analysis that US EPA's Scientific Review Panel that met in San Francisco in February 2003 determined that the amphibole asbestos

found in the sampling is believed to be more than 100 times more likely to cause mesothelioma than is chrysotile, and explain what that means relative to total risk (e.g., 1 in 100 rather than 1 in 10,000). [Footnote 1: Information submitted by Berman and Crump to the US EPA's Scientific Review Panel suggests that amphibole asbestos may be 600 to 700 times more potent in initiating mesothelioma and 5 times more potent in initiating lung cancer.]

ATSDR Response: *The results were intentionally presented qualitatively (without specific risk numbers) in order to emphasize the very uncertain nature of the risks calculated. As described in the text of the report, risks are calculated by multiplying estimated lifetime average exposure by EPA's Integrated Risk Information System (IRIS) unit risk of 0.23.*

The method used to estimate risks in the health consultation is the same as used in the IRIS update. The risk coefficients in this update were developed from several epidemiology studies of asbestos workers. As evaluated in the IRIS update, the studies were found to be too uncertain to differentiate effects of chrysotile vs. amphibole fibers. Although a scientific consensus that amphibole fibers may be more toxic than chrysotile fibers in causing mesothelioma is developing, it is not appropriate to multiply IRIS-calculated risks to correct for amphibole exposures, since risks from both fiber types (as well as risk for both lung cancer and mesothelioma) were combined in the analysis.

El Dorado Community Group Comment:

Relative to completeness of the EPA study, it would be helpful to acknowledge that not all possible sources of exposure were included. For example, only areas within the campus boundary were considered, whereas external areas, such as the cross-country route used for practice by student athletes, have not been acknowledged. Also, not all sports fields were tested. The football field is an example, excluded because it is covered with grass. But activity-based testing at the soccer field, also covered with grass, yielded greatly elevated levels of asbestos. Mowing of the football field generates significant amounts of dust, suggesting that would be the case also for games played there. These aspects could be included in the subsequent health consultation mentioned on p. 7.

ATSDR Response: *The activity-based sampling results provided to ATSDR included sampling at the football field track, baseball fields, basketball courts, and tennis courts during sweeping or dragging bare areas of the field (e.g., the track around the football field or the baseball infield). Although it was not possible to sample or otherwise account for every spot that could be a potential source of exposure, it is believed that the areas with the most significant risk of exposure were identified and subsequently mitigated.*

El Dorado Community Group Comment:

Further analyses we'd like to see in the Health Consultation:

- The cumulative effect of exposure by multiple pathways.

ATSDR Response: *ATSDR evaluated multiple exposure pathways considered to take place at Oak Ridge High School. ATSDR will be evaluating potential exposures at other locations in the community in a future health consultation.*

El Dorado Community Group Comment:

- Information about ambient levels in the absence of disturbance. The school district obtained measurements of this nature of 0.0026 structures per cubic centimeter, corresponding to 2600 structures per cubic meter. This is similar to the “reference” levels obtained in October 2004 one week after heavy rainfall, as mentioned at the public meeting on 6 May 2005. It also represents a considerable level of inhalation of amphibole fibers in a supposedly “clean” environment. Please analyze the risk associated with ambient levels of this magnitude in the absence of disturbance.

ATSDR Response: *ATSDR is concerned about total asbestos exposure and did not consider “background” measurements in the health consultation. ATSDR will review recent sampling results obtained to determine whether an evaluation of these asbestos levels in the community is possible.*

El Dorado Community Group Comment:

- Analysis of fiber lengths. The Consultation says on p. 13 that “information about the size distribution of detected fibers...was inadequate.” However, this information is needed to perform the action in the first bullet under Public Health Action Plan on p. 16. Please clarify this inconsistency and/or provide the analysis beyond the discussion, p. 25, in response to a comment by peer reviewer Lippmann.

ATSDR Response: *The data collected in Fall 2004 by EPA will have detailed size distribution information collected on all detected fibers. ATSDR will use that fiber size data in its evaluation of community exposures for a future health consultation.*

El Dorado Community Group Comment:

Given the long latency period, we realize that a Health Assessment would have little value applied to members of the general student population, but it could be of value for long-time staff in the three highest risk categories, and perhaps for some others who have had exposure through multiple pathways.

We concur with your recommendations as given on p. 16. Please, however, consider some further recommendations:

- Mitigation techniques have been carried out on sports fields, and in various outdoor locations on the high school campus. We are concerned that periodic follow-up air sampling is not planned to verify compliance. Without this, adequacy of the mitigation has not been determined. As you properly note at the top of p. 8, “Ongoing sampling of classrooms is essential to confirm the safety of the classrooms over time, prove efficacy of the cleaning program, and confirm that recontamination is not taking place.” Periodic monitoring also should take place to determine long-term effectiveness of all mitigation measures, both indoors and outdoors. Application of CARB’s ATCM rule, which allows asbestos content of up to 0.25% in materials that might be imported in future outdoor maintenance activities, will not be protective of public health applied to amphibole asbestos. Please include a recommendation that a regulatory agency (e.g., the Department of Toxic Substances Control) commit to appropriate long-term monitoring.

[Footnote 2: School district staff say (pers. comm.) that the Operation and Maintenance plan is not being properly carried out so as to be sure that the campus remains free of asbestos.]

ATSDR Response: *DTSC's School Property Evaluation and Cleanup Division entered into an agreement with the district to review and approve the O&M Plan for Oak Ridge High School. The plan establishes EDUHSD's policy for managing naturally occurring asbestos on the school campus [46]. The primary objective of this O&M Plan is to ensure the integrity of the cap and prevent exposures to soils laying beneath the cap. The plan does not address or consider potential exposure from unmitigated areas, from off-campus track-in, or from other off-campus sources.*

ATSDR has reviewed the new O&M plan and submitted comments to DTSC on January 3, 2006. DTSC has agreed with the comments made by ATSDR and is currently working with EDUHSD to amend the agreement to include the changes. Because the new plan does not include steps ATSDR considers vital to limiting exposures in the future, recommendations for monitoring and/or cleaning school classrooms were added to the recommendations section of this document. As an advisory agency, ATSDR cannot set requirements or enforce any plan that is put into place. Local and/or state authorities have responsibility for enforcing operations and maintenance plans.

El Dorado Community Group Comment:

- AHERA needs updating. When AHERA was first implemented, detection limits were such that standards were set that were not protective. In the interest of public health, please include a recommendation that AHERA be updated.

ATSDR Response: *AHERA was not used in ATSDR's evaluation. AHERA regulations are not health-based. ATSDR is participating in inter-agency workgroups implementing new information into current asbestos risk models to contribute towards improving the health protectiveness of current asbestos regulations.*

El Dorado Community Group Comment:

At the top of p. 27, ATSDR responds to a peer-review comment with a discussion of the possible increased risk to children from exposure to asbestos. It may be correct that this risk may be less for high-school age children than for younger ones. Nevertheless, for the benefit of families with younger children living in the general area, we think ATSDR should acknowledge here or elsewhere in the Consultation that environmental studies elsewhere have suggested that the increased risk to children may be as much as several orders of magnitude.

ATSDR Response: *ATSDR recognizes that children are at increased risk from exposure to asbestos. This is mainly due to the longer life expectancy of children, increasing the risk of asbestos-related diseases that take many years to develop. The focus of this health consultation was high school-aged students and staff at Oak Ridge High School. ATSDR plans to specifically consider earlier child exposures in a future health consultation on community exposures.*

El Dorado Community Group Comment:

We look forward to the additional health consultation referred to on p. 7 that will address exposure pathways and assessments for situations in addition to those at Oak Ridge High School.

Thanks to all the members of your team.

D2. Comments from El Dorado Union High School District:

Re: Health Consultation at Oak Ridge High School
EPA Facility ID: CAN000906055

Dear ATSDR:

Please consider these comments submitted by the El Dorado Union High School District to the Health Consultation for Asbestos Exposures at Oak Ridge High School, 1120 Harvard Way, El Dorado Hills, California, dated May 6, 2005.

The District would like to extend its appreciation to ATSDR for preparing the Consultation (the "Report") and for all of your work on this matter. All comments are submitted in the spirit of improving future consultations prepared by your Agency, including the upcoming consultation you have mentioned for El Dorado Hills and the majority are intended to expand the level of information provided to the ultimate audience, the Oak Ridge High School community.

Some of our comments relate to information that could have been incorporated into the initial draft, if the District had been consulted. For example, a few of our comments are related to District operations and school schedules because several of the fundamental assumptions central to the analysis fail to correspond with actual District operations and school schedules. We hope you will be able to correct these assumptions in the final report and would encourage you to confer with the District as necessary to incorporate the correct information.

For your convenience we have prepared our comments to correspond to specific references and pages in the Report. The comments are submitted chronologically and not in order of importance.

Page 1

We think that additional background information would greatly improve the overall readability of the document. We suggest that before the discussion regarding ORHS, a more general discussion of the prevalence of NOA in California and the emergence of general population exposure to NOA as a potential public health issue would be helpful. Also, the statement regarding knowledge of NOA in the area at the time the school was built could be construed as implying that special precautions were appropriate at that time, when in fact, it does not appear that there was any agency guidance at all. If the ATSDR could put the emerging nature of concern over NOA into context, it would clarify this point for the readers.

ATSDR Response: *ATSDR agrees that more background information could give helpful perspective on asbestos issues for the lay reader. Based on discussions with school and county officials, ATSDR plans to prepare a summary of historical and background information relating to this topic. This will be published either independently or in conjunction with the upcoming health consultation on community exposures. In the interest of finalizing the Oak Ridge High School health consultation in a timely manner, ATSDR is releasing this document without the requested additional background information.*

District Comment:

The historical discussion raises the question as to whether asbestos fibers were released during the construction of the soccer fields when, in fact, there are monitoring data that provide some information. We believe it would clarify the point if it could be noted that air monitoring was conducted during the construction. This included the placement of air monitoring equipment in the breathing zone of the driver of the scraper moving asbestos containing material from the cut area to placement in the fill area. Additionally, perimeter air monitoring was performed directly downwind from the area of excavation. Visible dust emissions at the cut slope excavation were minimized. No visible dust emissions left the construction site. No asbestos was detected in either air monitor. We've provided the test results as Attachment 1. This point is further discussed under Page 9.

ATSDR Response: *It is ATSDR's understanding that ATCM dust suppression measures were appropriately followed during construction of the soccer fields. It is not known, however, whether fibers were released while the soccer fields sat uncovered after asbestos was discovered, or at some other time not captured by the monitoring performed.*

District Comment:

Page 2

The Report states that most of the asbestos fibers were of the amphibole type. It would help if the report clarified if this generalization is based on air or soil tests and referenced the document used to reach this conclusion. We are also confused because Appendix B states that "fibrous amphiboles" were identified. It was our understanding that the tests did not distinguish between cleavage fragments and fibers. The District geologist informs us that it would be more correct to state that amphibole structures with aspect ratios greater than 3:1 were identified and therefore classified as fibers. In addition, the "Summary of Indoor Air Sample Results" attached to the Report notes the presence of actinolite structures, not fibers. We note this to acknowledge the current discussion in the scientific and health communities regarding the importance of distinguishing between cleavage fragments and fibers. The ISO test method states in the abstract description that it is not capable of differentiating cleavage fragments. One of many important reports addressing this issue is attached as Attachment 2. We also note the discussion on Page 5 regarding the interchangeability of f/cc and s/cc, which seems to add to the confusion. We believe that a section should be added to the report that more fully describes the methods of analysis for asbestos and the confounding factors that make interpretation of results so difficult. Otherwise, the lay reader will be unaware of the important distinctions.

ATSDR Response: *It is ATSDR's position that cleavage fragments fitting dimensional criteria (e.g., width, length, and aspect ratio) defined for fibers carry equivalent risk and should be counted and evaluated the same as fibers. There is no need to analytically determine whether a particle meeting pre-defined dimensional criteria resulted from original fiber growth or from cleavage.*

District Comment:

Pages 3-4

The Report references exposure in other areas such as Cypress, China and New Caledonia. The Report notes the exposure levels are not available for these areas and that it "...is not possible to extrapolate these findings to other areas in an attempt to predict the likelihood of disease." We believe we have seen some information suggesting that local use of asbestos (or asbestos-like) containing minerals was associated with high exposure potential in these areas (e.g., whitewash). The value of this reference to environmental exposures in these areas would be improved if a qualitative description of the exposure were added. As it reads, it would be interpreted as indicating that low environmental levels were associated with disease, which we don't believe is true.

ATSDR Response: *Some villagers in environmental exposure studies did handle asbestos and use it in their daily lives; however, ATSDR found no studies that explicitly studied the link between direct exposure or exposure level and disease. The studies do show that exposure to asbestos at levels lower than those typically associated with occupational settings is associated with disease. There is simply not enough information available to determine the extent to which exposures in California vs. other "environmental exposure" areas might be similar or different.*

District Comment:

The last paragraph on Page 3 begins a discussion of regulatory standards. We find it confusing. The Report references the 0.0009 f/cc level developed in response to the World Trade Center attack. As presented in the Report, we understand that this level is based on an occupational cancer risk of 1 in 10,000 over a 35-year occupational exposure. The implication is that this level was used at schools and other public buildings after the WTC attack and it was under this premise that the EPA required the 0.0009 f/cc clearance level for ORHS. We have since been informed that the clearance level of .01 f/cc has historically been used for schools and other public buildings and that the EPA never imposed a 0.0009 clearance level for schools within the WTC contamination area. We would appreciate if you could clarify this point, as the implication is that the EPA used the 0.0009 clearance level for public schools and the implications for interpreting the monitoring results from ORHS are significant. If in fact ORHS is the only school in the nation for which the EPA has used a 0.0009 f/cc clearance level, this should be noted in the report.

We also think that this would be the appropriate spot in the report to put a concise, readable summary of the process of generating a cancer potency slope for asbestos. It is badly needed and needs to be put in front of the generated cancer estimates. The discussion should describe the process of generating a cancer potency

slope, the underlying cancer data utilized for the extrapolation and a very plain language explanation of the applicability of the cancer risk estimates in describing cancer risks at much lower exposure levels.

ATSDR Response: *ATSDR will include some background on these topics in the supplementary information being developed. It is beyond the scope of this health consultation to provide complete background and history of regulatory development and risk assessment methods used or to compare findings at Oak Ridge High School with other schools in the United States.*

District Comment:

Pages 5-6

The Report discusses dust collected from a classroom that was potentially affected from a leaf blower. We think it would be advisable to qualify this data as being of unknown validity. We know that there is no chain of custody for this dust sample. A certified industrial hygienist did not collect the sample. The sample was taken to a lab that was not EPA certified. The collection method was apparently not a validated OSHA, NIOSH, or ASTM method for collection of asbestos in dust. The District is informed that the laboratory previously failed an EPA audit and is not used by the EPA for asbestos sample analysis. The District subsequently tested the room using the modified-aggressive EPA Superfund Sampling Protocol with a detection limit of 0.0005 f/cc and it came back as “no detect.” The room was not cleaned prior to testing. If reference is made to the dust data, the validity should be qualified in a footnote.

ATSDR Response: *ATSDR included reference to the cited dust sample in an effort to describe all data provided to the Agency. The result of the sample in question was not used in the exposure estimation, and its validity was not rigorously assessed by the Agency.*

District Comment:

Pages 7-8

The Report states that there is limited information about past levels of asbestos taken in air around the school. While we understand more data is always desirable, Page 4 of the Report does note the 1998 and 1999 data from CARB and the ambient air samples taken in outdoor locations at the school. Page 4 also references the 1998, 2002 and 2003 indoor air samples. We don't believe this data was sufficiently highlighted in the Report and think that its inclusion could add considerably to the qualitative risk analysis. If the earlier data were utilized it could decrease the speculation inherent in extrapolating the most recent results to scenarios that are not very applicable.

ATSDR Response: *The past indoor air sampling in classrooms had detection limits higher than many of the more recent samples and did not provide sufficient information to tell whether classrooms had more or less asbestos in the past. Ambient air samples taken outdoors are not appropriate to use to make conclusions about past classroom levels.*

District Comment:

The transite countertops referenced at the top of Page 8 were not removed from the classroom; they were encapsulated per AHERA standards.

ATSDR Response: *ATSDR has modified the text to indicate this.*

Page 8 states that “[T]he .0009 f/cc level is considered safe for classroom occupancy.” We assume this relates back to the risk based exposure estimate associated with an increased risk of 1 in 10,000 over an occupational lifetime. Again, we believe this concept should be clarified versus the 0.01-f/cc criteria. We have been told that the ORHS is the only school in the nation that has cleared to the 0.0009 f/cc level. If so, this should be highlighted in the report. Also, it would be helpful to explain whether there is a proposal to implement the 0.0009 f/cc standard under any state or federal regulations if it has been determined to be the safe level for classroom occupancy.

ATSDR Response: *ATSDR determined that the 0.0009 f/cc level was safe for classroom use in this situation. ATSDR does not have authority to set regulatory clearance levels. It is beyond the scope of this document to compare findings at Oak Ridge High School with other schools in the United States, and ATSDR made no attempt to do so.*

District Comment:

Page 9

The Report states that ATSDR is using data from dragging the baseball field as potential exposure to students, staff and spectators during sporting events, practices and events. We think it is important to add additional descriptive language on what this entailed. This procedure involved dragging the field by a tractor for over an hour, creating a large dust cloud. No water was used to wet the area. In fact, this procedure resulted in heavy loading of the filters with dust, requiring one of the filters to be tested under the indirect test method. The mental image for the reader, we believe, will be something much different and it will impact their interpretation of the exposure estimates based on air results collected during the event.

ATSDR Response: *ATSDR received many reports of dust clouds being created during sports events and other activities on sports fields, so dragging the field to create a dust cloud was deemed to reasonably represent potential exposures.*

District Comment:

Additionally, we note that the results from the indirect test method were incorporated into the analysis. We have read that the scientific community agrees that the indirect test method is prone to error and excessive readings because the process of diluting the filters in water has the potential to cause the structures or bundles to break and to be counted more than once. However, the indirect sample, with a reading of 0.1023, appears to be the sample used by ATSDR in the exposure analysis and risk assessment. Two other samples collected during this event were analyzed under the direct method, with results of 0.0163 and 0.0653. To us, it would appear to be more appropriate to either use the samples analyzed under the direct method or to use an average. This type of complexity in analyzing asbestos is one of the reasons we suggested earlier that the Report incorporate (in the body of the report) a lay language summary of test methods, comparisons and difficulties.

We understand that the qualitative risk evaluation is intended to be a screening, worst-case analysis. To us, however, the likely extreme nature of extrapolating from dust generation due to dragging the field with a tractor to participant and spectator exposure is likely to be missed by the casual lay reader and they will interpret the qualitative risk numbers as reflecting actual personal risk. We hope that the report will be edited to either more clearly describe the artificial nature of the air measurements (including footnotes in risk tables for those readers that might tend to skip reading the text) or utilize a more realistic derivative of the measured levels in describing personal exposures in the area or, preferably, both. The assumption that dragging the field with a tractor simulates activity-based exposure is unnecessarily conservative. Perhaps, some estimate of the degree to which the analytical data overestimates likely exposures could be added.

The Report assumes a prior exposure level in the classrooms of .005 f/cc even though all of the pre-cleaning tests did not detect asbestos. Again, we understand that it is common practice in risk assessments to assume that a “chemical” is present in the environment at one-half of the detection limit, but this nuance is not adequately explained in the report for the lay reader. We believe that the report would be more informative if this issue was discussed in more detail in the text. We would also like to see the “non-detect” results extrapolated to exposures in a more refined manner. Would it be possible to include a range of exposures in the risk estimates where non-detect values were extrapolated as “zero” asbestos? Alternatively, now that additional community background measurements are available, non-detects could be interpreted as equivalent to background (non-zero). The classrooms were tested under the AHERA standards, which is the federal standard for all schools. Further, the results are similar to the 1998 and 1999 CARB tests. Without this type of correction, we believe the message of the health consultancy report will be lost due to criticism of what appears to be overly conservative assumptions.

Additional information that could refine the report could come from more refined description of site activities. For example, although classrooms were cleaned in the spring and summer of 2003, much of the area on the east side of campus still had bare dirt areas. In fact the classrooms were cleaned prior to the track dragging activity and associated air monitoring and the “leaf blower incident.” Over a year passed from the time of cleaning before the EPA conducted their tests using aggressive testing methods and the EPA noted that several of these rooms did not appear to have been cleaned. We believe the aggressive sampling method used by the EPA, which involved the use of leaf blowers without prior cleaning of the rooms, presents a likely highly conservative surrogate for exposure. Yet, the results were much lower than the .005-f/cc level assumed in the Report. At a minimum, we would like to see this information incorporated into the report and, preferably, used in the exposure calculations.

In line with the above information, the section regarding the classroom assumptions seems unnecessarily speculative and possibly very unscientific to the lay reader. The last sentence under the classroom section states that exposure “could have occurred there” and the subsequent exposure analysis uses this premise to justify an assumed exposure of .005 f/cc. To the careful reader, this extrapolation will not appear justified, while the casual reader will likely miss the “screening” concept all together and assume that the exposure estimates are likely. We think the value of the report would

increase dramatically, if this extrapolation were either explained better, or preferably, a more refined analysis of classroom exposure was derived and incorporated into the analysis.

Page 9 also discusses the construction of the soccer fields. The soccer field construction and the concern over the potential release of asbestos during the soccer field was the basis for involvement by the EPA. While we think the detail related to exposure and likely lack of health effects due to the activity is important for the Report, we also believe the Report should reflect that tests were performed during the soccer field construction and a personal air monitor was worn by the grading operator. No release of asbestos fibers was detected. This paragraph also appears to assume that best management practices and wetting the soil and other dust control measures did not start until after the mitigation began. We would like to see this clarified to more clearly present that best management practices were used from the outset of this project.

The discussion regarding the baseball and softball fields should clarify that most of the baseball fields and softball fields as well as the track consisted of imported soil. While this does not change the potential exposure, it does speak to the issue of general conditions in El Dorado Hills and implications for administrative control measure. Further, this paragraph draws conclusions about the softball fields based on soil samples and references soil samples containing greater than 1% asbestos. There may be errors in this presentation. Please recall that the District provided ATSDR and the EPA with the split sample results from these soil samples. The split samples were tested by an EPA certified lab and results ranged from .0001 to .0002. We think the split sample results should also be included in this section of the report, particularly since wide discrepancies in soil samples appears commonplace. A copy of the split sample results is attached as Attachment 3. This type of complication could also be a general topic to be included in the new asbestos analysis section.

Again, we think the extrapolation of results from the tractor activity to participant/spectator exposure is unnecessarily conservative and detracts from the consultancy. It is our concern that the community of readers will react to this conservatism in at least two ways. The first type will assume that the screening, qualitative risk numbers reflect reality and be highly alarmed. The second type will cite the extremely conservative assumptions as examples of why the Report is meaningless. Either way negates the value of the Report. We believe, a more balanced (or refined) analysis that could include a range of risk values based on various possible (probable?) assumptions and a much more detailed explanation of the use of measured values and their impact on risk estimates would greatly increase the value of the report as the community moves forward in dealing with the local NOA issues.

Page 9 also references the tests on the tennis or basketball courts. The Report notes that the tests were conducted while the courts were swept with a broom. Again, we believe this to be an overly conservative assumption that would benefit from a better discussion in the Report and, preferably, a more refined incorporation into exposure assumptions.

ATSDR Response: *ATSDR attempted to highlight the uncertainties involved in the exposure estimation in the original health consultation. Despite the considerable uncertainties, we feel that it is reasonable to assume that some exposure to asbestos was experienced by students and*

staff who spent considerable time outdoors and that these groups should be aware of their potential exposure. Many details about the assumptions made are debatable; however, ATSDR used professional judgment to attempt to balance uncertainties. Refining the exposure estimates are not likely to change results enough that overall conclusions and recommendation in the health consultation would change. ATSDR plans to evaluate more recent data collected in the community by EPA and may update conclusions and recommendations for Oak Ridge High School, if warranted by that evaluation.

District Comment:

Page 10

Please refer to our comments regarding exposures for baseball and tennis activities described above. We have the same concerns regarding the football field and track. In addition, please note that separate soil tests were taken for the football field, and no action was deemed necessary to mitigate the football field. This suggests that it could be inappropriate to extrapolate the air measurements to these activities. Accordingly, an alternative level of exposure should be assumed for football practice.

In regard to the dirt parking lots, the Report notes that trace levels of asbestos were in the soil. We believe it would be helpful if the levels detected were included in the Report. The Report notes that although no information is available concerning airborne levels in the parking lot, that disturbing soils that contain trace levels of asbestos can result in suspended fibers at levels of concern without noting that data is also available showing that the disturbance of soil containing trace levels does not result in suspended fibers at levels of concern. While we understand the screening nature of the analysis, we believe this type of presentation detracts from the value of the Report. More importantly, the Report assumes that levels in the air in the parking lot were similar to the single highest test conducted on the baseball field when a tractor dragged the field and the indirect test method was used. This assumption is made even though the levels in the soil in the parking lot varied significantly from the levels in the baseball field. This is another area where we believe the Report would greatly benefit from both a better description of the basis for the assumptions and the effect on the overall analysis, or preferably, the use of a more refined estimate of air concentration.

Page 10 also discusses the assumed exposure from paths and other bare areas on campus. The report cites soil samples taken from bare areas on the campus. We would like the Report to reference the specific samples. As mentioned above, we believe the Report should also reference the corresponding split sample results of the soil included in Attachment 3. Specifically, although the Report notes that soils on bare areas of the campus tested greater than 1% asbestos, the split sample results do not agree with the EPA soil tests. Additionally, Table 2 indicates that 0.01 f/cc was presumed to represent the air concentration of asbestos in the area, based on an unadjusted extrapolation from area monitor results taken during the activity-based sampling. The rationale for this extrapolation is missing, but it seems to be unnecessarily conservative. We believe that the Report would benefit from either a better description of the presumed relationship between the activity monitoring results and the concentrations of asbestos in the area of the paths or a more refined estimate of air concentration or both. It would seem possible to derive a relative value for the paths as some fraction of the activity-based monitoring results based on both differences in soil concentrations and differences in soil particulate

release from typical activities. Again, we believe the Report will be subject to unnecessary criticism if the assumptions are unnecessarily conservative. At a minimum, the inclusion of a range of possible air concentrations, exposures and risk for any scenario would greatly improve the information content.

ATSDR Response: *Due to problems with reproducibility and the ability of different laboratories to even detect asbestos in soil and bulk samples, ATSDR is unable to make any correlations or assumptions about airborne asbestos levels based on soil results. Photos provided to ATSDR of dust in the dirt parking lot in the past indicated that dust levels were high during times of automobile traffic, and because fragments of amphibole asbestos were found in the parking lot it is reasonable to assume airborne asbestos levels were similar to those measured while dragging baseball infields. Likewise, paths and bare areas of campus, many of which were close to areas where high dust levels might occur, were felt to be similar to the stationary monitors near fields being dragged. In addition, the limited number of activity based samples collected mean that the highest values measured do not necessarily correspond to the highest values possible. The use of the highest value was felt to balance uncertainties in either direction. ATSDR attempted to highlight the uncertainties associated with these assumptions in the document and in presentations to the community.*

District Comment:

Page 11

This page sets forth the estimated exposure levels for teachers and students. The Report assumes that coaches are involved in an activity-based exposure for six and one-half (6-½) hours a day, three hundred and sixty-five (365) days a year. Further, the Report assumes additional classroom level exposure of three and one-half (3 ½) hours a day five days a week for fifty-two (52) weeks a year. We've noted our concerns regarding the extrapolation of air measurements above. We also think that more refined exposure assumptions, beyond those associated with air concentrations, would greatly improve the report and would require little additional effort. For an extreme example, the information we have indicates that it is not reasonable to presume that a coach might be exposed for 6 ½ hours a day, 365 days a year to airborne concentrations measured during the field dragging event with the issues regarding the validity of those results, even as a worst-case, upper-bound. If anything, a more reasonable exposure scenario based on the more likely exposure duration should be added to the report to present a range of possible exposures, although we would prefer to see the current assumptions refined. For example, the tests were taken in the middle of summer when school is out of session. We also believe seasonal effects (e.g. rain) would modify airborne concentrations. Again, while we appreciate that the intent of the Report is to provide a qualitative estimate of risk with some very conservative assumptions, we believe the nuance of that particular policy approach is lost in the report. The inclusion of a more refined evaluation would be appropriate. The District can assist ATSDR in selecting more refined exposure assumptions for our staff.

Other examples are found in the chart on page 11. For example, it is assumed that outdoor maintenance staff is involved in activity-based exposures seven and one-half (7 ½) hours a day, five days a week. We believe that this greatly exaggerates actual activities and is unnecessarily conservative. The District can help ATSDR select more

realistic (but still upper-bound) activity patterns. As another example, the chart uses the single highest reading derived from dragging the baseball field with a tractor as the level of exposure for all student athletes for three and one-half (3 ½) hours a day, 365 days a year. Additional classroom exposure is assumed for six and one-half (6 ½) hours a day, five days a week, 52 weeks a year. We think these assumptions are unnecessarily conservative by not incorporating the actual school schedule and practices of the students and the effect of the seasons and the watering schedule of the fields. The same types of comments apply to the other exposure scenarios.

ATSDR Response: *ATSDR used the best information it had to make reasonable assumptions about past and present exposures. Assumptions made for exposure were chosen conservatively, in an effort to balance other factors that might lead to underestimation of risk. Changing assumed exposure concentration and frequency and duration of assumed exposure would change the estimated risk proportionally. However, ATSDR considers it unlikely that changes in exposure assumptions would change the risk enough to modify the conclusions and recommendations made in the original document.*

District Comment:

The very last sentence on page 11 seems inappropriate. To us, placing “or lower” in parentheses editorially decreases the likelihood that ATSDR actually believes the exposures could be lower. From our reading and the issues described above, while there can be no argument that estimating historical exposures is highly uncertain, we believe that the intent of the Report was to not underestimate exposures and, if anything, the bias is towards overestimating exposure.

ATSDR Response: *The sentence reads “It should be noted that although ATSDR in general selected the highest appropriate concentration as a protective “worst case” estimate, the limited nature of the available data leave open the possibility that concentrations present in actual exposures could have been significantly higher (or lower).” Choosing the highest value as a “worst case” involves an implicit assumption that actual exposures are lower. This sentence was added to indicate that because of the limited nature of the available data, the choice of the highest value might not represent actual “worst case” exposure.*

District Comment:

Page 12

This page discusses the assumed exposure levels for sports spectators. We understand that the level is directly extrapolated from the highest area monitor result during activity-based testing. At a minimum, the conservative nature of this assumption should be more fully expressed in the report. We also believe that the value of the Report would be greatly increased if this value could be refined to remove the unnecessarily conservative impact on the qualitative risk analysis. For example, simple adjustments regarding wind direction and seasonal influences would likely significantly decrease exposure concentration estimates.

ATSDR Response: *The original assumption made for spectators is felt to be reasonable. In addition to the stands being next to the track, where clouds of dust were reported to ATSDR*

during football games, there was asbestos present in several areas beneath the stands which could have contributed to exposures there (for example, if children played beneath the stands while games were being played). ATSDR attempted to emphasize the uncertainty inherent in the assumptions and calculations made, but at the same time the Agency is not sure that the assumptions made are the worst case assumptions that could be made.

District Comment:

Page 13

As noted earlier, we believe the basis for the cancer potency slope and its use should be prominently presented early in the report. The early information would make interpreting the “Estimation of Risk from Potential Past Exposures” much easier for the lay reader. It would also be of benefit to include the formula for calculating risk based on average lifetime fiber concentration. To reiterate our earlier comments, we think it is extremely important that the report present the underlying philosophy of cancer potency slope generation and their use. We believe too many people do not understand their derivation (in general terms) and interpret risk estimates as actual risk. For example, does ATSDR consider this slope factor to truly calculate the risk for low-level exposure of asbestos? The concepts we find in the 2002 Toxicology Profile (i.e., “large degree of uncertainty in extrapolating from the available data to levels of exposure that may be several orders of magnitude lower than the current US occupational exposure limit of 0.1 f/mL.”) is extremely valuable, but doesn’t come across in the Report. Similarly, Page 18 of the Toxicology Profile states there is “considerable uncertainty in using a linear, no-threshold model for calculating health risks.” We think these are important concepts. We also understand that there is information that amphibole fibers may be more risky than those found in the workplace. This concept is reiterated clearly in the report. There does appear to be, however, other information suggesting that there is a threshold for the carcinogenic effect of asbestos. This concept is equally important to present.

ATSDR Response: *Cancer risk assessment for asbestos is performed using an assumption that there is no threshold for causing disease. This assumption does involve significant uncertainty, since little is known about if and how very low exposures contribute to the risk of disease. However, this method is used in the absence of scientific certainty because we still need a way to estimate risk to determine whether public health action is needed.*

District Comment:

We note that the report describes the risk analysis as “qualitative”. While we believe that means that there is considerable uncertainty in the analysis and that as a result the risk numbers presented are general approximations, we also believe that the term as used is confusing. To many readers, qualitative means it does not include numbers and calculations. Would it be possible to provide more description? Even changing the term to “screening evaluation” would help. For example, exposures could be quantified in terms of multiples of area “background”. If ATSDR wanted to present risk estimates, “background” risk would then be the starting point.

ATSDR Response: *ATSDR attempted to describe the risk resulting from past exposures, which is dependent on the cumulative exposure, not just exposure above a background level. We*

recognize that knowledge of background levels would be very helpful to local authorities in making risk management decisions, but this information is not needed to calculate whether a given exposure would increase the risk of disease. In fact, because exposures away from the school area were not considered, the exposures estimated in the health consultation would actually underestimate total exposure and therefore the risk of disease.

District Comment:

We believe that the information in the paragraph below Table 4 should be introduced early in the report as discussed above. The uncertainty associated with the use of the EPA model is additionally discussed on Page 14 in the uncertainty section and the paragraph detracts from the information in Table 4.

ATSDR Response: *The comment is noted. ATSDR feels the information needs to be located near Table 4 to explain why the specific risk numbers are not presented.*

District Comment:

Page 14 -15

Page 14 discusses off-campus exposures and states that amphibole asbestos occurs throughout the area of California where Oak Ridge High School is located. It should be noted that this may be true in many counties in California and in other areas of the United States. We would like to see a broader discussion of background issues at the beginning of the report to place the issues in the proper context. For example, Page 15 states that the exposures were high enough to “increase” the risk of adverse health effects. This statement would be more meaningful if it included a discussion of exposures in other areas to use as background. We understand detectable levels of asbestos two and one-half (2.5) times higher than the background samples taken by CARB at ORHS have been measured thirteen miles out in the Pacific Ocean. <http://www.asbestos.org/HealthEffects/Non-Occupational.html>. A copy of this article is included as Attachment 4. According to tests completed by CARB during the period between 1998 and 2003, daily background levels in Santa Clara County were seventeen (17) times higher than the readings at ORHS even before the EPA completed their work at ORHS. Readings in Monterey County were three and one-half (3.5) times higher than the readings at ORHS. See Attachment 5. Recent readings in the Clear Creek Management Area indicate that the levels are over 100 times the readings at ORHS. Since there are background levels in many areas in California and the United States, the exposures at ORHS should be put in context of other areas with naturally occurring asbestos.

ATSDR Response: *It is beyond the scope of this document to analyze other areas besides Oak Ridge High School, but ATSDR recognizes that the situation at Oak Ridge High School and in El Dorado County is not unique. Although every situation is different, it is hoped that studying this area will give us information that can be applied to other areas with similar situations. ATSDR is working with EPA in Region 9 and in several other regions to make consistent public health recommendations regarding asbestos exposures at several sites.*

District Comment:

Appendix B

In Appendix B, the Asbestos Overview, it would be helpful to set out the various standards and regulations regarding asbestos. It should be noted that existing standards use exposure limits higher than those considered acceptable in the report.

- OSHA .1 f/cc
- World Trade Center Working Group - .01 f/cc
- NIOSH - .1 f/cc
- AHERA - .01 f/cc (by PCM); 70 s/mm²

ATSDR Response: *These levels were cited merely for information; ATSDR does not consider these values to be appropriate for application to environmental community exposures.*

District Comment:

Appendix C

The reports from the Cancer Surveillance Program should be attached to the Report. A copy is included as Attachment 6.

ATSDR Response: *ATSDR does not typically attach other groups' reports to its health consultations and assessments. The original report can be requested from the originating agency.*

District Comment:

Thank you for affording us the opportunity to respond to your Health Consultation report. We fully share your interest in protecting the public's health and have done our utmost to provide a safe environment for our students, staff, and the public. We concur with many of the comments made by your peer reviewer, Dr. Morton Lippmann. In regard to the many uncertainties involved in the analysis, Dr. Lippmann comments that.... "it was disturbing that worst case interpretations of them, rather than more balanced interpretations, were used in estimating risks". Also, in commenting on the appropriateness of the report's conclusions and recommendations, Dr Lippmann states "[B]ased on the objective evidence presented, the risks of cumulative past exposures are so low that clinically detectable evidence of measurable effects is extremely small".

ATSDR Response: *ATSDR generally uses conservative assumptions when many uncertainties exist in order to be protective of public health. ATSDR recognizes Dr. Lippmann's concerns about the conservative nature of the exposure assumptions; however, ATSDR also recognizes the nonconservative approaches of current asbestos risk models, especially when those models are used to evaluate the risk posed by amphibole fibers. This consultation's findings indicate that groups that were highly exposed to asbestos at the school might have an increased risk of developing disease and that minimizing chances for further exposures is warranted. The findings of this consultation do not mean that all (or any) members of exposed groups will develop asbestos-related disease.*

The final statement in this comment is speculative. No attempt to measure potential effects of exposure in a clinical setting has been made in this community. The state of asbestos science is

such that presence or absence of clinical manifestations of asbestos disease cannot be predicted for a given exposure, especially low-level, non-occupational exposures. Any known exposure is considered to increase the risk of developing asbestos-related disease. While the absolute levels of exposure for particular individuals in the past will never be known, it is prudent public health policy to inform them of their potential for past exposure, so they can in turn inform their personal physician.

District Comment:

While we understand the desire to not underestimate the risk, we also believe the report will be more useful if it is based upon more refined estimates of exposure. We believe that providing a range of potential exposures (and calculated risks) from low level, to probable exposures, to high level exposure assumptions, would provide the public with more useful information while still allowing ATSDR to address the worst case scenarios.

ATSDR Response: *Due to the considerable uncertainty in estimating past exposures, ATSDR does not feel including a range of exposure assumptions is warranted or useful in this case. ATSDR is currently working with EPA Region 9 and OEHHA to develop ranges of exposure assumptions as described to evaluate the more recent data collected in El Dorado Hills.*

D3. Comments from a private citizen:

Dear Agency for Toxic Substances and Disease Registry,

Thank you very much for the opportunity to submit comments on the Health Consultation regarding asbestos exposures at Oak Ridge High School. I greatly appreciate the time and thought that went into this excellent report.

I have the following questions:

1) 15 years is listed as the longest duration for potential exposures in your risk assessment. Was this an average? How old is the school? Are there staff who have worked there longer and wouldn't they be at higher risk if there have been additional years of exposure? Given the varying length of work history, would it be appropriate in your risk chart (Table 4) to segment risk based on years of exposure to help staff and community members better understand their actual risk? (For instance, risk for one year, five years, 10 years, etc.)

ATSDR Response: *Fifteen years was chosen as a typical exposure for a long-time teacher at the school. Because the school was constructed in 1980, it is possible that some staff members worked at the school for longer than 15 years. Their exposure, and risk, would be increased proportionally to the additional time they were exposed.*

Citizen Comment:

2) Can you explain in more detail what it means to have a “greater than 1 in 10,000 risk” for developing mesothelioma (page 13). How much greater? I have heard that the risk is 1 in 100 for some groups. Is it 1 in 100 risk, or higher?

ATSDR Response: *The excess cancer risk was calculated using EPA’s IRIS update to be greater than 1 in 10,000 but less than 1 in 1,000 for developing cancer (including both lung cancer and mesothelioma). No groups were calculated to have a greater (1 in 100) risk. A 1 in 10,000 excess risk means that, for every 10,000 people with a given exposure, one additional cancer would develop over the expected “background” rate of cancer. EPA usually considers risks in the range of 1 in 1,000,000 to 1 in 10,000 to be acceptable for its cleanup purposes.*

Citizen Comment:

3) Is there a threshold of risk from a regulatory standpoint that demands emergency action to stop further exposures? In other words, given your risk assessments, haven’t we reached an actionable level of risk where disturbing amphibole asbestos areas needs to be banned or strictly regulated so that children are not unknowingly further exposed, and their risk increased?

ATSDR Response: *Unfortunately, the uncertainties and debate among the scientific community preclude setting health-based regulatory or action levels at this time. Risk assessment is one piece of information among many that must be considered when making risk management decisions. We anticipate that action levels can be better defined as more knowledge is gained about asbestos exposure and how it contributes to disease.*

Citizen Comment:

4) Given that the geology of Oak Ridge High School is similar to areas studied by the US EPA in its El Dorado Hills Naturally Occurring Asbestos Multi Media Assessment and the finding that the nature trail and other natural areas in the vicinity of the school measured significant airborne exposures of amphibole asbestos, it should be assumed from a precautionary and risk assessment standpoint that the entire school was built on ground containing asbestos (in addition to imported fill used for sport fields that also may have contained asbestos). When the school was built, and during subsequent additions and improvements, there would have been heavy dust generated from truck traffic, construction activities, and other machinery on site, particularly during a time prior to having dust mitigation rules in place. Shouldn’t these additional exposures be calculated in your risk assessment to students, staff and public who were exposed during those periods of construction activities during the school’s history? It might also be expected that these asbestos exposures would have been potentially higher than the scenarios calculated since the heavy pulverization of asbestos-bearing rock and dirt caused by heavy truck and machinery traffic may have generated more airborne exposures.

ATSDR Response: *ATSDR is unable to estimate past exposures as described because no data on levels of airborne asbestos during construction of the school are available. ATSDR’s use of conservative assumptions in its exposure estimates was meant to attempt to balance uncertainty about whether actual exposures were higher or lower.*

Citizen Comment:

5) Construction workers were not included in your chart. Given the assumptions outlined in #4 above regarding the geology of the entire site of the school, and given that construction workers would have worked in classrooms, and outside on projects, and have been exposed during construction activities at the school, shouldn't construction workers be included in your risk assessments?

ATSDR Response: *ATSDR did not attempt to include every possible group potentially exposed to asbestos, but only representative groups. Anyone who had exposure to similar dusts as those evaluated in the report could have had exposure to asbestos as well.*

Citizen Comment:

Thank you for your attention to these questions and concerns.

D4. Comments from California OEHHA:

Office of Environmental Health Hazard Assessment comments on Health Consultation (Public Comment Release): Asbestos Exposures at Oak Ridge High School

Comment 1

The Asbestos Background section (page 2) of the document states “Many scientists believe that amphibole asbestos fibers have a potency for causing mesothelioma that is as much as 100 times greater than that of chrysotile fibers, mainly because of increased persistence of amphiboles in the lungs”. Crocidolite may have the highest cancer potency of the amphibole fiber series based on occupational epidemiology studies, but it is not clear that the other amphiboles (e.g. tremolite, actinolite, amosite) are equipotent, since good epidemiological cancer data does not exist for several of those fiber types (especially tremolite). Therefore, the above statement appears to be overly broad in its conclusion. Additionally, the only quantitative epidemiologically-based cancer estimate in the literature of which OEHHA is aware of is the estimate done by Hodgson and Darnton. That estimate in our opinion underestimates the potency of chrysotile by ignoring without reason the South Carolina textile cohort in their analysis. Further, they include mining and milling which have the lowest risk estimate probably because the structures counted were not all respirable (more so than other occupations studied). US EPA did not include these mining and milling studies in their potency estimate for that reason. Therefore, the ratio of cancer potencies between chrysotile and the amphiboles is probably artifactually large. It should also be noted that Nolan et al. (1994) found primarily short chrysotile fibers in parenchymal lung tissue specimens from an American pleural mesothelioma case, and reports by Suzuki and Yuen (2001) and Suzuki et al. (2005) also found the predominant fiber type in lung and mesothelial tissue from human mesothelioma cases to be short chrysotile.

ATSDR Response: *ATSDR did not mean to imply that chrysotile does not cause mesothelioma or other disease—it does. The number cited (100 times) was not intended to be a hard number but rather to indicate the general consensus that amphiboles are thought to be much more potent*

than chrysotile in causing mesothelioma. More research is needed to determine the exact relative potencies, both between amphiboles and chrysotile and between different amphibole varieties.

OEHHA Comment:

Comment 2

The Asbestos Background section (page 4) of the document states “The 0.0009 f/cc level is based on EPA’s current asbestos cancer slope factor for combined lung cancer and mesothelioma, with a 1 in 10,000 increased risk over a 35-year occupancy. This slope factor was derived without consideration for the probable increased toxicity of amphibole fibers for causing mesothelioma”. The epidemiology studies which form the basis of both the CalEPA and US EPA potency factors were of mixed exposures, some mostly chrysotile, others mostly various amphibole fibers including crocidolite. The resultant potency factor used by US EPA therefore includes the influence of those amphibole exposures on mesothelioma incidence.

ATSDR Response: *The statement has been reworded to read “This slope factor was derived from a group of epidemiology studies of various chrysotile, amphibole, and mixed asbestos exposures. The derivation assumed chrysotile and amphibole asbestos have equal potency for causing cancer.”*

OEHHA Comment:

Comment 3

The Purpose of the Report section (page 5) of the document states “For the purposes of the exposure estimates and analysis in this consultation, ATSDR treated equivalently the two units of measure, structures per cubic centimeter (s/cc) and f/cc”, and “ATSDR noted that structures greater than 5 μm in length contributed 50% or more to the total structure count. Therefore, estimates of exposure using the total structure count and those using only structures greater than 5 μm in length will differ by only a factor of two”. It cannot be necessarily assumed that a given number of asbestos structures observed using TEM in an asbestos sample which are $> 5 \mu\text{m}$ in length will equate to the same number of asbestos fibers observed under PCM. Hwang and Gibbs (1981) and Hwang and Wang (1983) observed TEM/PCM ratios ranging from approximately 5 – 2000. The document would be strengthened by a description of the uncertainty associated with using this assumption in the risk analyses. Additionally, ATSDR may wish to determine the ratio of PCM-equivalent structures to PCM fibers for samples where both analytical methods were used to develop structure and fiber counts.

ATSDR Response: *Not enough information exists to determine these ratios for the data used in this health consultation. Based on a preliminary evaluation of the activity-based sampling collected by EPA in fall of 2004, the assumption is a reasonable one. Those data showed AHERA TEM structure to PCMe fiber ratios were between about 1 and 3 for most samples. For a few samples where fill materials were apparently contaminated with short chrysotile fibers, the ratios were between about 4 and 30. Although data are not available to confirm the assumption*

made in evaluating the Oak Ridge High School data, the assumption is reasonable given the more recent data, which are likely to be similar in nature to the school data.

OEHHA Comment:

Comment 4

The risk estimation in the Exposure Assessment and Toxicological Evaluation section on Page 13 is really a semi-quantitative presentation with very large risk bounds for the upper and lower risk categories. The document would benefit from an acknowledgement of this fact. Also, the document states “The use of this model likely underestimates risk because the fibrous amphibole asbestos found at the school poses an increased risk for disease, especially for mesothelioma”. As mentioned in Comment 1, there is a substantial amount of uncertainty associated with an estimation of the possible differences in the ability of chrysotile and the individual amphiboles to induce mesothelioma. Also, the above statement suggests that there is a difference between chrysotile and the amphiboles in both lung cancer-induction potency and the ability to induce noncancer disease, which probably is not true. Additionally, as mentioned in Comment 2, the cancer potency factors used by US EPA and Cal/EPA include the influence of those amphibole exposures on mesothelioma incidence. It must also be considered that the El Dorado Hills airborne asbestos samples are probably very heterogeneous with respect to fiber type and length, making it difficult to draw an overarching conclusion about the effect of fiber type/length on the cancer potency associated with those samples. It would be more accurate to say that “the use of this model may underestimate mesothelioma risk”.

ATSDR Response: *ATSDR attempted to emphasize the uncertainties in the risk estimation in the document, both in the “uncertainties” section and by presenting the risk estimations qualitatively (without specific risk numbers). There is ongoing debate among scientists regarding various aspects of asbestos science, but the current position of ATSDR is that both chrysotile and amphibole asbestos cause disease. Amphibole asbestos may be slightly more potent in causing lung cancer, and may be many times more potent than chrysotile in causing mesothelioma. Although noncancer effects are understood less, it is reasonable to assume that the risk of developing other effects would also be greater because amphibole fibers remain in the lung much longer than chrysotile fibers.*

OEHHA Comment:

Comment 5

The Health Outcome Data section (page 14) of the document states “No difference was found between observed and expected rates of mesothelioma incidence” in western El Dorado County. However, given the sample size and latency period for mesothelioma, it is unlikely that a modest increase in mesothelioma in western El Dorado County would be detectable. Those caveats are discussed in Appendix C. A brief mention of those caveats in the Health Outcome Data section would make the document more accurate. ATSDR may also wish to mention the manuscript by Pan et al. (2005), which described an potential increased risk of mesothelioma associated with residence near areas containing naturally occurring asbestos.

ATSDR Response: Additional discussion from Appendix C and a discussion of the referenced epidemiological study (which only became available after the public comment release of this document) have been added to the text as suggested.

OEHHA Comment:

Comment 6

The Public Health Action Plan (page 16) of the document states “ATSDR will evaluate EPA data being collected and use it with the Berman and Crump asbestos risk model to assess risks of amphibole exposure at Oak Ridge High School and other nearby areas with naturally occurring asbestos”. The Berman and Crump asbestos risk model has not been adequately peer-reviewed, nor has it been formally adopted by US EPA. That model assigns extremely low cancer potencies to asbestos fibers less than 20 µm in length. However, animal and human data (Hesterberg et al., 1998; Suzuki and Yuen, 2002; Suzuki et al., 2005) suggest that the fiber size/potency assumptions made by Berman and Crump may be inaccurate. ATSDR may wish to reconsider this action.

ATSDR Response: ATSDR recognizes that the Berman and Crump asbestos risk model has not been formally adopted by EPA and suffers from some inadequacies. However, it does attempt to account for effects of mineralogy and fiber dimensions thought to be more potent in causing disease. We realize that asbestos science is evolving and that further research is modifying currently held notions of fiber sizes and types most responsible for disease, but for now we believe that a model that includes these considerations can give additional perspective on risk. ATSDR is currently determining how best to evaluate more recent data and may ultimately use a risk model modified from Berman and Crump, or another model altogether. The discussion in the text of the document has been changed accordingly.

OEHHA Comment:

References

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Suzuki Y, Yuen SR. (2002) Asbestos fibers contributing to the induction of human malignant mesothelioma. Ann NY Acad Sci. 982:160-76.

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D5. Comments from a private citizen:

Citizen Comment:

BACKGROUND

The Health Consultation states a citizen petitioned ATSDR for a Health Consultation after veins of asbestos were disturbed during construction of a Oak Ridge High School (ORHS) soccer field in 2002. While chronologically correct, the statement implies the petition was submitted as a result of exposed veins from soccer field construction. Based upon review of past documents, that is not the case. Community members petitioned ATSDR as a last resort, and as a direct result of countless other petitions to assess the area were rejected by regulatory agencies. Independent Petitions to assess Oak Ridge High School and neighboring Silva Valley Elementary School began as early as April 1998, and continued through 2002, however, were also rejected by all responsible agencies, including school districts and County. All rejections were issued despite documented evidence that the area of the schools and surrounding properties were 100% contaminated with Tremolite-Actinolite Amphibole Asbestos.

ATSDR Response: *ATSDR recognizes that the petitioner had been active in the community for several years prior to petitioning ATSDR. In an attempt to convey this point in a concise way, the background was reworded to state, “A community member, who had been active for several years in voicing concern over asbestos exposures in the area, asked the Agency for Toxic Substances and Disease Registry (ATSDR) to evaluate the public health implications of current and past asbestos exposures of students and staff at the high school.”*

Citizen Comment:

PEER REVIEW

When peer reviewers were asked, “Does the public Health Consultation adequately describe past and present pathways of human exposure to asbestos at Oak Ridge High School,” each answered “yes.” While I appreciate what ATSDR is trying to accomplish here, that answer can only be based on assumptions. Without having direct communication with residents or students, past or current personal knowledge of ORHS, the peer reviewers are technically incapable of properly answering that question. Peer reviewers are incapable of knowing whether any exposure pathways, past or present, have been omitted or improperly described in the Consultation, therefore, their opinion on this question should be reserved.

ATSDR Response: *The comment is noted.*

Citizen Comment:

HISTORY

Although partially correct, ATSDR's statement, "Because of community concerns about asbestos, the California Air Resources Board (CARB) performing (sic) ambient air sampling at the school in 1998 and 1999 (no asbestos was detected)" implies proper exposure assessment of ambient air was conducted at ORHS those years, and that simply is not the case.

The purpose of CARB's 1998 3-day test at ORHS was to determine if ambient "background" asbestos levels could be captured from a rooftop, not at breathing zone levels. At the time, CARB claimed it lacked personnel to supervisor monitors at breathing zone levels so monitors were placed high onto rooftop, away from students. The true purpose of CARB's 1999 test was to determine if a heavily watered area, immediately west of Silva Valley Elementary School, released fibers in the direction of ORHS during activity (refer to report). Without this important background information, an uninformed reader could be lulled into believing a true assessment of ambient air within breathing zone levels had been conducted at ORHS, thereby allow a reader into falsely believing little to no background exposure occurred those years.

In summary, prior to ATSDR's involvement in 2003, an assessment within student breathing zone level had never taken place at ORHS (neither ambient nor activity-based sampling). ATSDR's Consultation also incorrectly states asbestos was not detected at ORHS in 1998 or 1999. On the contrary, it is believed asbestos was indeed detected in air at the ORHS sampling site, in both 1998 and 1999, respectively. I believe the discrepancy is due in part to inconsistency among commercial labs and lack of training in some cases. In any event, Amphibole Asbestos was indeed identified on filter, however, went unreported in 1998 and possibly 1999, while Chrysotile Asbestos was found and reported in the 1999 report and listed at 0.0019 Chrysotile fibers per Cubic Centimeter. (See Attachment A for discussion)

ATSDR Response: *ATSDR's reference for the ambient monitoring was CARB's website. Because the results were not used in exposure estimation, no attempt to research or verify either purpose for the monitoring or sampling procedures used was made.*

Citizen Comment:

ASBESTOS BACKGROUND

Amphibole Asbestos is also known to exist in non-ultramafic formations as well as ultramafic. (e.g.-Monterey County, City of Folsom).

ATSDR Response: *Asbestos can be formed from many different types of metamorphosed rock, including granitic, carbonate, and ultramafic. It is most commonly associated with ultramafic rocks.*

Citizen Comment:

ASBESTOS HEALTH EFFECTS

Malignant Mesothelioma

Consultation states “Many scientists believe that amphibole asbestos fibers have a potency for causing mesothelioma that is as much as 100 times greater than that of Chrysotile fibers...” While the statement may be correct, the Berman Crumpt [*sic*] Model statistically suggests certain length Amphibole Asbestos fibers (>7 microns) begin to show a toxicity of approximately 700 times greater than that of Chrysotile for initiating mesothelioma. Because certain USEPA’s eleven member Scientific Review Panel (SRP) felt more study was still needed, and a unanimous position was required, the SRP chose to support the less toxic rating of 2 orders of magnitude until further information could be gathered. In conclusion, many scientists believe the potency of certain length and width of amphiboles fibers may be many more times greater than just 100 times for initiating mesothelioma.

ATSDR Response: *The number cited (100 times) indicates the general consensus that amphiboles are thought to be much more potent than chrysotile in causing mesothelioma. Studies of various amphiboles showed increased potencies compared to chrysotile ranging from no increase to more than 600 times for crocidolite. More research is needed to determine exact relative potencies, both between amphiboles and chrysotile and between different amphibole types.*

Citizen Comment:

Lung Cancer

Many scientists believe Amphibole Asbestos exposure increases the risk to lung cancer as compared to Chrysotile. According to the Berman and Crumpt [*sic*] Model which incorporates over 100 asbestos studies for comparison purposes, statistically, certain Amphibole Asbestos fibers appear to be 5 times more toxic than Chrysotile for initiating Lung cancer. USEPA’s SRP felt more study was needed before supporting that risk level. In contrast to mesothelioma, it is extremely difficult to make an official proclamation with respect to lung cancer due to competing exposures (toxins), including but not limited to cigarette smoke. Therefore, exposure to Amphiboles Asbestos fibers may be a factor in the increase of lung cancer but definitive information is lacking. As with mesothelioma, more study/information is needed.

ATSDR Response: *Amphibole fibers may be slightly more potent than chrysotile fibers in causing lung cancer. ATSDR agrees that further research could clarify this point.*

Citizen Comment:

Noncancer effects

The Consultation does not discuss the possibility some systemic autoimmune disorders may be associated with asbestos exposure, nor does it discuss other types of cancer (e.g.- larynx).

The Consultation does not discuss, in detail, the greater risk to stomach and GI cancer with Amphibole as compared with Chrysotile. While I understand data is limited, Chrysotile is known to break down in hydrochloric acid, whereas Amphibole does not, therefore, Amphibole Asbestos may carry greater risk due to its needle-like structure and resistance to gastric juices.

ATSDR Response: *These issues are beyond the scope of this document. Asbestos exposure carries a far greater risk for cancer and non-cancer lung diseases than other diseases. Many of the statements made by the commenter have not attained a consensus in the scientific community and would require more research before they could be stated as fact.*

Citizen Comment:

The Consultation refers to workers' exposure allowance of 0.1 fibers per cubic centimeter but does not disclose to readers that adult workers are required to wear fitted respiratory protection, be certified to wear respiratory protection, and are trained in protecting themselves so that exposure to airborne fibers are held to a minimum.

ATSDR Response: *The statement is true; however, ATSDR would like to point out that this information was not withheld for any reason except brevity. ATSDR states in the document more than once that it does not consider the worker PEL to be protective of community exposures.*

Citizen Comment:

Environmental Data Evaluated

The Consultation states "not all data types reviewed were appropriate to use for estimating exposures." Please describe all data types not used and explain why ATSDR did not find information relevant in calculating risk to children. Also, please explain why ATSDR chose not to use the County's and school district's official documents that declare asbestos "background" level for ORHS to be 0.0026 Actinolite fibers per cubic centimeter. That ambient figure corresponds to other measurements gathered for the area. Please calculate risk of inhaling 0.0026 amphibole f/cc as background (without activity).

ATSDR Response: *ATSDR did not use soil or dust data to estimate exposures because difficulties in obtaining representative bulk samples, nonstandardized bulk sampling methods, and inconsistent results obtained by different laboratories make it impossible to predict airborne fiber levels resulting from a measured bulk concentration.*

Risk depends on the cumulative exposure, not additional exposure above a background. ATSDR did not consider risk of ambient levels since we were concerned with overall risk, and since activity-based sampling would capture both activity-related exposures and ambient (background) exposures. ATSDR will be evaluating reference samples collected by EPA in Fall 2004 which may give more knowledge about community asbestos levels in the absence of activity.

Citizen Comment:

Indoor Air Sampling

Please explain the calculation used by ATSDR in its Cancer Risk Evaluation Guide (CREG) for risk inside the classrooms. Please state the conversion factor used from PCM to TEM, and TEM to PCM, and why a particular figure was chosen, whatever it may be.

ATSDR Response: *The CREG was not used to calculate risk. The procedure used to calculate average lifetime exposure and resulting risk are presented on pages 12–14. No specific conversion factor was used to convert PCM and TEM measurements because fiber concentration values (PCMe fibers used in IRIS risk assessment) were assumed for various activities based on TEM measurements. On the basis of more recent sampling in similar areas, using TEM measurements for PCMe fiber concentration will tend to overestimate actual PCMe fiber count, but values are typically within the same order of magnitude.*

Citizen Comment:

Outdoor Air Sampling

Please note all areas on campus where bulk sampling and analysis did not take place, nor were evaluated for exposure pathway via activity-based air sampling. (e.g.—science class digging in and around soil)

The Consultation refers to CARB’s 8-day sampling period from a rooftop of the school’s gymnasium (’98 & ’99) and erroneously assumes the data collected, (‘zero’ asbestos fibers captured in air) “represent exposure of the general public in the absence of soil disturbance.” That position is false and misleading. Furthermore, the purpose of 5 out of the 8 testing days cited (1999) was intended to measure fibers released during soil disturbance next to Silva Valley School, contrary to what the Consultation states (see CARB 1999 report). Testing only began after several water tenders released several loads of water throughout area to be evaluated. Surely ATSDR does not believe that action is normal or representative of a typical day.

ATSDR Response: *The health consultation discusses the limited nature of the available data. Not every location on campus could be tested, and not every possible exposure scenario could be evaluated. Representative exposure scenarios were evaluated which incorporated the available air sampling data, focusing primarily on activity-based sampling. Because the ambient air monitoring results obtained from CARB’s website were not used in exposure estimation, no attempt to research or verify either purpose for the monitoring or sampling procedures used was made. ATSDR will be evaluating air sampling data collected by EPA in Fall 2004 to evaluate exposures to the general public in a future health consultation.*

Citizen Comment:

With respect to monitoring the school track with a drag, it is important to note personal air monitor was placed on the driver of the tractor, many feet ahead of the drag, which was pulled. Therefore, there is the possibility exposure level measured on driver (f/cc) is far less than it would have been if monitor had measured actual dust cloud. As found in Libby, Montana, student-athletes who ran on Libby’s contaminated track ran a greater risk of exposure if in the middle of a pack of children, and even greater at the end of the pack, whereas children at the front of the pack had minimal exposure (as compared to the other children running) due to dust cloud (pig pen effect).

ATSDR Response: *Personal air monitors were worn by three contractors during each task, one who operated the tractor and two who worked in the field while the tractor was being operated. All three were exposed to dust from clouds generated [personal communication, Brian Stewart, MACTEC, September 27, 2005]. The highest asbestos level out of the three measurements per*

task was used in exposure calculations. ATSDR considers this to conservatively represent exposures that could occur during typical activities.

Citizen Comment:

Soil/Dust Sampling

The Consultation states soil and dust data are of limited use in predicting potential exposure. While true no one can predict exact fiber count in air (f/cc) simply based on results of bulk test, loose fiber count found within soil at concentrations of 0.001% or greater are known to generate more than 100,000 fibers per cubic meter of air in breathing zone when disturbed (refer to Weis & Addison).

ATSDR Response: *In some circumstances soils with trace levels of fibers can, when disturbed, result in high levels of airborne fibers; however, the amount of airborne fiber generation is dependent on many factors, including soil characteristics, moisture level, meteorological conditions, and the type of activity conducted. In other circumstances disturbing soils with even high levels of asbestos might result in very few airborne fibers. There is currently no correlation available for predicting airborne fiber level from soil bulk measurements. In addition, methods for determining fiber concentration in soil are not standardized and not easily reproducible between laboratories. These reasons are why ATSDR does not use soil measurements directly in estimating exposures, but only as an indirect indication of whether asbestos is present.*

Citizen Comment:

Current Status of Site

The Consultation is wrong to conclude “Current exposures to asbestos have been minimized...” The Consultation is also wrong to conclude ORHS as a “past public health hazard.” Based upon ambient background levels measured, airborne emissions will most likely continue to rain down onto school property at a rate between 1000 to 50000 fibers per square foot per 24 hours. Likewise, runoff will most likely carry fibers from exposed veins on Harvard way and neighboring properties and will be carried onto ORHS property due to slope, eventually settle and become airborne on or near campus once dry. Until all point sources are properly identified, evaluated and mitigated, routes of exposure pathways at school may continue, therefore, a declaration of ‘minimized’ exposure should be withheld.

Moreover, based on observations by certified geologists, the soil of the ORHS football field was composed of the exact same material as the ORHS running track and determined to be contaminated with Amphibole Asbestos. Despite repeated requests, the football field was never evaluated for exposure pathway, nor mitigated. According to USEPA at the time, it was not necessary to evaluate football field because it theorized grass would not release fibers into the air due to assumed moisture content of grass. USEPA based its opinion on some vague study it invoked, however, could not produce or recollect exact name of study. Since the time that position was taken by USEPA, USEPA has conducted activity-based sampling at the nearby Community Service District’s (CSD) soccer field and has learned asbestos emissions are indeed produced from grass after all. What are true exposure levels at ORHS football field, never evaluated due to miscalculation?

ATSDR Response: *The comments are noted. ATSDR defines a “past public health hazard” as a hazard that occurred in the past, regardless of whether it is present currently. ATSDR based its conclusions on the best information available at this time. If further information comes to light which would change the conclusions, ATSDR would update conclusions and recommendations as necessary in a letter or addendum to this document.*

Citizen Comment:

Lastly, for reasons unknown to this day, the remediation project at ORHS did not include a post-mitigation analysis plan with air tests to validate the success or failure of mitigation theories/procedures. Good science requires validation of theories through tests for confirmation purposes.

In August of 2003, ATSDR prematurely declared ORHS exposures were minimized at that time too, therefore, ATSDR should not rush to judgment today as it did in the past. This will ensure all pathways have truly been identified, evaluated and minimized. If ATSDR does not take this precautionary approach, the school district will reject all future requests for further testing. As a reminder to the 2003 incident cited, Superfund action began at ORHS 3 months after USEPA and ATSDR declared exposures minimized in August 2003. However, after 158 dirt samples were collected in November of 2003, Amphiboles Asbestos levels in soil were found to be greater than 1% (up to 6%). In summation, the school district needs to provide supporting air data to ATSDR and/or USEPA before a serious declaration of “minimized” can be officially declared.

Case-in-point--In Libby, after remediation work on Libby’s track was complete, an air sampling plan was instituted to ensure remediation work was as successful as theorized. What USEPA Region VIII learned from post mitigation analysis was remediation work did not meet the criteria it had sought and track was ordered redone. In conclusion, no air tests have been conducted to ensure the success of mitigation work at ORHS, therefore, ATSDR cannot make a valid claim exposures have been minimized on campus.

ATSDR Response: *ATSDR reviewed a draft operations and maintenance (O&M) plan prepared for the EDUHSC. At that time, ATSDR concluded that the O&M plan provided adequate controls to prevent future exposures. Since then, at the request of the EDUHSD, DTSC’s School Property Evaluation and Cleanup Division entered into an agreement with the district to review and approve the O&M Plan for Oak Ridge High School. The revised O&M Plan establishes EDUHSD’s policy for managing naturally occurring asbestos on the school campus [46]. The primary objective of this O&M Plan is to ensure the integrity of the cap and prevent exposures to soils laying beneath the cap. The plan does not address or consider potential exposure from unmitigated areas, from off-campus track-in, or from other off-campus sources.*

ATSDR has reviewed the new O&M plan and submitted comments to DTSC on January 3, 2006. DTSC has agreed with the comments made by ATSDR and is currently working with EDUHSD to amend the agreement to include the changes. Because the new plan does not include steps ATSDR considers vital to limiting exposures in the future, recommendations for monitoring and/or cleaning school classrooms were added to the recommendations section of this document. As an advisory agency, ATSDR cannot set requirements or enforce any plan that is put into

place. Local and/or state authorities have responsibility for enforcing operations and maintenance plans.

Citizen Comment:

Exposure Pathway Analysis

Consultation should discuss areas and activities on campus not evaluated for exposure pathway.

Consultation does not discuss exposure pathway from ambient air, exposures unrelated to activities. According to official county and school district records, ambient air within breathing zone at ORHS is estimated to contain 0.0026 actinolite f/cc. Please develop risk assessment based on this figure while using the USEPA 1986 risk model.

ATSDR Response: *ATSDR evaluated representative exposure scenarios because not every possible exposure scenario could be evaluated. ATSDR evaluated risk from past exposures, which is dependent on the cumulative exposure, not just exposure above a background level. We recognize that knowledge of background levels would be very helpful to local authorities in making risk management decisions, but this information is not needed to calculate whether a given exposure would increase the risk of disease.*

Citizen Comment:

Estimation of Potential Past Exposures

Consultation should acknowledge that USEPA's 1986 risk model (calculation) has been proven unacceptable in terms of accurately estimating risk secondary to environmental exposure to Amphibole Asbestos.

ATSDR Response: *The 1986 risk model is useful as long as one bears in mind its limitations. ATSDR used this model in an effort to obtain a general idea about risk, since available data were not detailed enough to use other models. ATSDR is aware of the concerns about amphibole toxicity and therefore used exposure estimates that were extremely health protective.*

Citizen Comment:

The most suspect classrooms and air ducts were thoroughly decontaminated by an asbestos abatement company in 2003 prior to scheduled testing of classrooms. This direction came from the school district despite promising ATSDR cleaning would not take place until exposure assessment could be evaluated. Valuable information was forever lost, and may have been a good indicator of the need to increase frequency of cleaning. Today, however, routine and thorough cleaning (O & M) has been minimal, if at all.

As stated in Consultation, classrooms were tested by the school district without compliance of AHERA. Leaf blower was not used to initiate disturbance of classrooms, which is intended to simulate student activities while inside an occupied classroom. Without disturbance of amphibole fibers within classrooms as required, the heavy fibers (20% greater than Chrysotile) will not become airborne, thus severely skew test data. All tests not performed properly should be re-tested by school district until complete AHERA compliance is met and zero fiber count is achieved. Please note preamble to AHERA and its intent.

ATSDR Response: *ATSDR acknowledged the limited data and the uncertainty of the risk evaluation in the health consultation. The use of a leaf blower is meant to suspend all fibers in a classroom to prove efficacy of cleanup methods, not to simulate student activities. Technically, AHERA is not applicable in this situation; it applies when schools remove or remediate asbestos-containing building materials from school buildings.*

Citizen Comment:

According to air monitoring results for ORHS, student athletes were subjected to high level exposure to Amphibole Asbestos during the dry season. Based upon sampling protocol chosen by school district, the ORHS's running track appears to have released between a minimum of 44,100 Amphibole structures to 61,140 Amphibole structures per cubic meter of air (upwind). Because sampling results derived from an activity-based monitor placed onto a operator pulling a drag many feet behind, exposures to student athletes could have conceivably been much higher for students running in mass. Request to monitor dust cloud during actual track run with trained and certified Hazardous Materials Techs and Specs (volunteers at no charge) wearing Level B Haz Mat suits for protection (with respiratory protection) during run were repeatedly rejected by District. Had an actual re-enactment been allowed to take place by the District, a more accurate exposure model would have been produced.

ATSDR Response: *ATSDR acknowledged the limited data and the uncertainty of the risk evaluation in the health consultation. Additional sampling data would not change the conclusion that a public health hazard existed for students and staff.*

Citizen Comment:

The strict use of USEPA's 1986 risk assessment model in evaluating risk during exercising activities is a mistake. The outdated model assumes all scenarios that are evaluated, including but not limited to high-dose episodic exposures, occurs with an "at rest" breathing rate/volume of 0.833 cubic meters of air per hour (average adult). While the risk model may be useful for estimating risk while sitting in a classroom, library, bleachers or similar restful activity, it does not properly reflect nor properly estimate true exposure during strenuous exercise where respiratory rate, depth and total volume are known to increase by at least 4 to 5 times, as compared to at-rest volume rate. To more accurately calculate the number of fibers inhaled during each scenario evaluated, an estimate of inhalation volume (e.g.-- Liters per minute) should be used for exercise scenarios, especially during running a running scenario.

Student athletes running in the middle of a pack on ORHS's former track would have expected to receive moderate to high dose episodic exposure during each one hour run, while student athletes at the rear of the pack would expect to receive the highest exposure, depending upon weather conditions. With an increased respiratory rate and depth, hence total volume inhaled during one hour of strenuous exercise, the risk of inhaling between 249,335 to 375,000 amphibole asbestos structures per hour is indeed plausible. Please re-calculate risk using appropriate breathing rate and total volume for one, two and three hour runs, 5 days per week.

ATSDR Response: *The 1986 risk model is useful as long as one bears in mind its limitations. ATSDR used this model in an effort to obtain a general idea about risk, since available data were not detailed enough to use other models. Fiber level measurements in epidemiology studies on which the models are based are estimated averages over time, so risk estimates are necessarily also based on average fiber concentration breathed over time. Correcting for actual breathing rate during relatively short-term activities is not likely to change exposure estimates averaged over a lifetime to a significant degree.*

Citizen Comment:

Despite repeated requests to school officials to cease and desist its practice of requiring students to run off campus, through areas known to contain amphibole asbestos veins and shedding fibers, school officials continue to require students to run in mass, off campus, in areas never mitigated. The likelihood for amphibole exposure is significant, however, disregarded in this report. Please consider this as part of a school activity since parents have no control in protecting their children while children attend classes at ORHS.

ATSDR Response: *It was beyond the scope of this report to evaluate off-campus exposures. However, ATSDR will be evaluating exposures in the community in a future health consultation. That evaluation will address some of the areas in which students are reported to run off-campus.*

Citizen Comment:

In summation, in addition to the recommendations cited by the Consultation, I hereby request ATSDR to formally recommend the following changing to regulation relative to Amphiboles:

--Develop new risk model which takes into account actual respiratory rate and volume so that high-dose episodic can be more accurately calculated.

--Recommend to the State and Federal Government that all Amphibole fibers be recognized as harmful, thus regulated equally, so that transitional fibers and intergrowths are less of an issue in identifying specific Amphibole fibers.

Because of Amphiboles' double-silicon chain, they are more likely than not to possess intergrowth of other chemicals, than the standard commercial asbestos, or Chrysotile. Since the time the strict and narrow definition of asbestos was established, many more Amphiboles have been identified and interference with intergrowths recognized.

--Recommend to the State and Federal Governments that they establish an activity-based sampling protocol at breathing zone levels, especially when Amphibole Asbestos is involved. Amphiboles have a 20% greater molecular weight than the common Chrysotile and are less aerodynamic due to their needle-like structure. Because of that, many ambient or background monitoring will not capture most Amphiboles, whereas personal monitoring will. THIS IS ESPECIALLY TRUE WHEN AMBIENT MONITORS ARE PLACED ON ROOFTOP, AWAY FROM ANY KIND OF ACTIVITY.

--Recommend the to the State and Federal Governments to establish and implement a requirement to utilize high flow/high volume pumps (10-14 L/m) when measuring relatively clean environments. A minimum total of 4500 liters of air should be sampled. In the case of assessing an area heavy in airborne particulate matter, flows may be reduced, but not to a minimum. If filter overloading is a legitimate concern, length of

time for each filter should be reduced instead and new filters added. This procedure, however, will require more filters to be utilized and analyzed, therefore, should only be used when Amphibole Asbestos is a concern and risk to exposed population has the potential to be high.

--Recommend to the State and Federal Governments to require a minimum opening of at least 45 grids per air filter when Amphibole is involved, rather than just 10, due to Amphibole Asbestos' toxicity, hence risk. This requirement could have some flexibility, depending upon setting, meteorological conditions, exposure pathways, activities, frequency, and if children are present. In essence, the greater the risk, the greater sensitivity should be implemented.

--Recommend to the State and Federal Governments to develop and implement a multi-tiered testing procedure in bulk material analysis (e.g.-soil). A multi-tiered mechanism would provide a systematic approach in scrutinizing all bulk material used in various applications. An immediate example that comes to mind is the suggested requirement for greater sensitivity (magnification) when a material might contain Amphibole Asbestos intended for children's play.

Rationale for proposal--Currently, State and Federal law only require bulk analysis to be performed through the use of a 400 power Polarized Light Microscope ("PLM") and hundreds if not thousands of fine to ultra-fine Asbestos fibers are missed in each evaluation due to the limitation of PLM. With the implementation of a multi-tiered approach, Scanning Electron Microscope or "SEM" (500 X to 10000X) can be utilized if PLM does not initially detect fibers. In unusual situations where the greatest sensitivity is required to protect public health, Transmission Electron Microscope ("TEM") can then be used as a last step. This progressive procedure would, once again, be necessary when assurances are needed to ensure children or sensitive populations are not unnecessarily exposed to contaminated Amphiboles during play or activities that disturb soil, and risk to exposure is high. As learned from John Addison, Libby Montana, New York and El Dorado Hills research, as little as 0.001% in soil can generate over 100,000 fibers per cubic meter of air inside the breathing zone upon disturbance. (see Libby, Montana findings-Weis 2000 for a scanning electron microscope image of asbestos fibers in a soil sample that was below the limit of detection by PLM, and John Addison 1995)

ATSDR Response: *The commenter's recommendations are noted. ATSDR staff participate in several interagency and scientific workgroups developing recommendations to improve evaluation of asbestos exposure and risk.*

Citizen Comment:

ATTACHMENT A

CARB chose to place its air monitors on the rooftop of ORHS's gymnasium, during each noted test ('98 & '99), far away from normal activity and breathing zone of students. CARB also selected to strictly use low flow pumps at ORHS, not the preferred high flow pumps. According to CARB at the time, it did not possess enough batteries to operate high flow pumps due to commitments at other sites. During its 1998 test, without explanation, CARB chose not collect critical meteorological data during sampling period. Despite those questionable decisions and/or shortcomings, Amphibole Asbestos was

nevertheless still captured within filter, however, never formally reported in documentation.

Randomly chosen, a single 1998 sample was analyzed by one lab while a second lab was chosen to analyze a different section of the same filter (split sample). During analysis at second lab, at least one, possibly two Amphibole structures were observed. Because the structure possessed a trace amount of aluminum along its chain, (aluminum peak was below midline of silicon and magnesium peak), the structure was not reported in documentation, but verbally reported to CARB. According to the lab, the structure identified within the 10 grid area was indeed Amphibole but was not a regulated fiber due to intergrowth within the fiber. To support its position, the lab claimed the aluminum peak (Al1203) was slightly greater than 1.7%, therefore, according to the lab's reference material, could not be anything but "Hornblende." However, contradicting that position were other references, such as the American Mineralogist Vol 50, 1965, 963-977 and Basic Regional Metamorphic Rocks of the Klamath Mountains, Northern California by MJ Holdaway, p 965 demonstrate Actinolite Asbestos can and do possess aluminum peaks greater than 1.7%, ranging from 4% and 4.79% respectively.

Regardless of true chemical makeup of Amphibole Asbestos fibers examined, as found with Libby Montana Amphiboles, transitional fibers can often mislead lab technicians into believing that if chemical makeup does not match spectra analysis of one of six regulated fibers exactly, fibers and structures should go unreported as "Asbestos" due to strict interpretation of flawed and limiting regulation. This issue has been problematic for other sites as well, including but not limited to unregulated Amphibole fibers found in W.R. Grace's Zonolite product. Past disputes have also taken place regarding fibers found in Talc and fibers containing "too much" iron. Without the requirement for labs to possess knowledge of standards of known chemistry to calibrate their spectra, problems with properly identifying harmful Amphibole fibers will continue.

In the case of El Dorado soil, aluminum and iron rich clays and oxides are abundant. Some specific sites, such as the area of ORHS, also have Talc. It is my understanding those particles contribute to the spectra as well, therefore, an analyst really has to identify the mineral using various techniques as needed such as electron diffraction, and tilting the fibers into the right orientation to identify the mineral. Because of the complexity and time-consuming process, technicians are unable to accomplish this. Commercial labs operate for nominal fee and are required to process countless samples in a very short period of time, in order to be profitable, hence, stay in business.

In the case of CARB's primary lab of 1998 & 1999, I have been informed the lab does not consider nor classify Tremolite or Actinolite Asbestos as "Amphibole Asbestos" if a trace amount of Talc intergrowth is present along the fiber. This phenomenon appears to parallel debates at other sites dealing with same lab, according to my sources. This problem is also similar to the aluminum and iron scenario previously described. Because Talc is located within the veins of Tremolite-Actinolite Series of Oak Ridge High and elsewhere, it is highly probable CARB's principal lab allowed Amphibole Asbestos fibers to go unreported as well.

ATSDR Response: *Having no way to verify this information, ATSDR is unable to comment.*